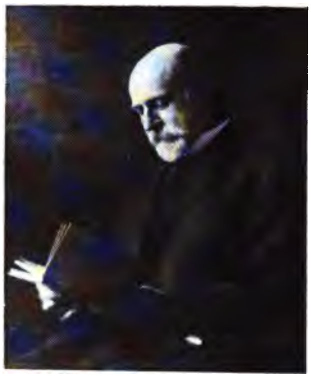
LIEBER.

GEOLOGICAL SURVEY

OF

SOUTH CAROLINA.

1856.



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REPORT

ON THE

Survey of South Carolina:

BEING THE

FIRST ANNUAL REPORT TO THE GENERAL ASSEMBLY OF SOUTH CAROLINA, EMBRACING THE PROGRESS OF THE SURVEY DURING THE YEAR 1856; WITH PLATES AND MAPS.

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CHAPTER I.

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A FEW preliminary remarks are always needed where subjects, more or less new to the reader, are broached. In the present instance this will be especially necessary, as I have found many who were but imperfectly acquainted with the general character and leading objects of the survey which is now in progress, and of which this is the first annual report. For the information of those, therefore, whom distance or other causes have left in ignorance of the motives which induced the ordering of this survey, it will scarcely be improper to present a few preliminary remarks.

The importance of our mineral wealth having, of late years, attracted the attention of those who perceived the necessity of its full investigation, and who appreciated the value which must attach to its being rendered available, the following resolutions were appended to the report of the Senate Committee, and were agreed to by both branches of the Legislature at the session of 1855—provisions for agricultural investigations having been added at a later date than the first motion in favor of the survey:

"*Resolved,* That this General Assembly authorize the appointment of a Geological, Mineralogical and Agricultural Surveyor, whose services shall be engaged for four years, and whose duty it shall be to explore the several Districts and make a geological map, analyze minerals, ores and manures, free of charge, and submit an annual report to the Legislature for general circulation."

"*Resolved,* That this Officer shall receive a salary of three thousand dollars; be appointed by joint resolution of the two houses; and that it shall be the duty of the joint committees of Agriculture and Internal Improvements of the Senate, and of Internal Improvements of the House, to nominate a suitable person to fill this office."

It was in accordance with these resolutions that I received my appointment, and it has been my earnest endeavor to carry out the survey in the manner directed and in agreement with the character with which it has been stamped by being referred to the committees named in the resolution, making it most essentially a measure of Internal Improvement.

Previous surveys had been carried on with a view almost exclusively to the perfection of agriculture, a determination of the leading features of our soils and the discovery of those mineral substances which might be usefully employed for the improvement of those soils. Other more valuable minerals were treated, as it were, additionally and received that attention only, which was induced by the interest which those who conducted the survey, felt in them. Three several investigations of the kind were made at different periods by Mr. Van Uxem, Mr. Ruffin and Mr. Tuomey. The first amounted to little more than an inspection of a few of the minerals of the State. The second was entirely agricultural, having for its chief object the discovery of marl beds, and was consequently confined to the low country. The third was a general survey of the whole State, in which, however, the Low-country received proportionately far greater attention than the Up-country, where the greater diversity of rocks and the greater value of the minerals deserve an infinitely more protracted examination. It was also conducted upon a plan of supposed economy and expedition

which could not be conducive to the greatest amount of accuracy. That it left many wants still unsatisfied, must be ascribed to the insufficiency of the time and money granted for the purpose. Nevertheless, this last survey was not without utility in indicating some general features, which were of service in pointing out the portion of the State, where it was most necessary that the present survey should find its earliest field of labor.

As the survey now in progress aims at far greater minuteness and accuracy than the preceding ones, it was of importance that sufficient time should be spent at all points. This was evidently the manifest desire of the Legislature in granting a term of at least four years. In consequence of this a less extensive area has been examined than would have been done, if general observations only had been sought. The more intricate the geognostic character of a region, the more time it must necessarily engross. In fact, so complicated are some of the fields—that presented by York District, for instance—that it is impossible to produce the high perfection of results attained in various European countries, without devoting to each of them the labors of an entire year, and being aided by a full corps of assistants. Still I believe I may say, without hesitation, that the maps of the four districts surveyed this year, (in which some geographical corrections have likewise been made, that can scarcely fail to increase their utility,) the plates and this report, which accompanies them, will prove it to have been my earnest desire to accomplish the utmost, which the means at my disposal permitted. The maps occupy a most prominent position among the results of such a survey, and as no pains or trouble have been spared in endeavoring to make them accurate, it may not be too great a presumption to express the hope that they will be found of permanent value. That they should present discrepancies with maps which were the results of surveys conducted with greater despatch, is so self-evident a matter that it is barely necessary to allude to the fact.

Before proceeding farther in this introduction, I shall avail myself of the opportunity thus afforded of expressing my obligations to the

residents of the districts surveyed, from whom I have invariably received the greatest assistance in their power to afford. To mention their names would be impossible, as the list would probably fill several pages. To J. Friedeman, Esq., I am, however, certainly most indebted, as he kindly accompanied me throughout the main portion of the field duties, which the great heat of last summer* rendered more arduous perhaps than might be expected in other years. Mr. Friedeman's thorough knowledge of mining engineering, and mining geognosy —a fact which his having passed through the whole course of tuition, practical and theoretical, at the far-famed mining school of Clausthal, and elsewhere in Germany, would of itself insure—and his extensive experience in the mines of North Carolina, especially in the talcose slate mines, were of the greatest value in the investigation of the analogous occurrences of metals in our State. It would be difficult and, indeed, scarcely possible to distinguish his labors from my own since he attached himself to the survey, and I am under still greater obligations to him as his valuable services were gratuitously rendered, a fact which was unfortunately made necessary on account of the inconsiderable amount of the appropriation and the necessary outfit expenses which, of course, fell somewhat heavily upon the first year.

A report, like the one now presented, on the work in progress must, as a matter of course, pre-suppose the existence among its readers of a knowledge of the outlines of that science, with the leading principles of which it is necessary to be somewhat familiar, to comprehend the objects and utility as well as the general character of a survey of the present kind. It will be evident to all that it is not proper that every annual report should commence with a dissertation on the sciences of Geognosy and Geology. There are numerous manuals which furnish this information. Still it will not be super-

* The temperature in my tents was for a long time from 1 P. M., to 3 P. M., 103°-106° Fah., and on one occasion I found that the Thermometer in the sun, but itself protected from the immediate action of the solar rays, rose to 130° Fah.

fluous to introduce here an explanation of the two terms geognosy and geology; as, unfortunately, the distinction between these two sciences is not usually made by writers in the English language, although in other tongues the fields which they occupy are universally separated and distinctly laid down.

Geognosy is the science which treats of the existing constituents of the surface of our globe, while Geology seeks to explain the manner in which they were formed, and their present characters and relative position produced. The difference is, therefore, quite as great as that which separates anatomy from physiology; the one deals with facts or rather with material substances; the other with laws and theories. Geognosy may, consequently, take its stand as a science without the assistance of geology, while the latter could not exist without the former. This report is, therefore, most prominently a geognostic one, the geological theories being only occasionally introduced where they were needed as explanations. The maps are essentially geognostic. Geological maps might be termed those which, like Sir Charles Lyell's, of the tertiary ocean and continent of Europe, represent the distribution of water and land at any one geological period, or those perhaps, also, which distinguish between formations referable to distinct ages. Such maps would point out the boundaries of the cretaceous and tertiary formations, of the weald and the oolith. But those, on the contrary, which exhibit the area occupied by each rock, distinguished by its petrographic characters, its composition and external appearance, must be designated as petrographic or geognostic maps. For all practical purposes, to the miner as well as the agriculturist, they are most valuable because they are necessarily more accurate and minute, and because they exhibit the position of rocks of different chemical composition.

Apart from the general features which characterize this report, and which have just been explained, it is distinguished by a leading object—the observations on the useful minerals—those as well, which are applied to practical purposes in their native forms, as those which have to pass through some chemical or mechanical operation, before their useful properties are made manifest. Among these the metals

hold with us, by far, the most prominent position; and as their mode of occurrence is not generally understood, and scarcely any books on the science of geognosy afford a proper explanation, this report would be very incomplete if it did not furnish the uninitiated with the means of comprehending the remarks on the natural occurrences of the metals in our State. It is on this account that I here introduce a sketch of the geognosy and geology of veins.

VEIN GEOGNOSY AND GEOLOGY.

The study of the peculiar geognostic features of veins, as well as of their geological peculiarities, has unfortunately received far less attention than their importance would merit—most geologists in our country being more fascinated with paleontological researches, than with that branch of the science which, undoubtedly, occupies the most prominent position in its application to practical purposes. Still more remarkable is the fact, when we consider that it was mining, which certainly gave the first impetus to the study of both geognosy and geology. The geologists of England and America have generally treated veins as the results of mere casual causes, subject to no laws, guided by no rules, and, consequently, incapable of being subjected to any methodic arrangement. The geologists of the continent of Europe alone seem to have regarded the matter in a more important light; and while much is still left for future investigations to establish, much has likewise been attained, and many points have been determined which explain the attending phenomena, and enable us to form conclusions regarding them, often with as much certainty as we would in the geognosy of stratified rocks. Among those men who have latterly accomplished most in the fields of vein geognosy and geology, we may particularize the well known names of Elie de Beaumont, Fournet, Combes, Delesse, Von Weissenbach, Zimmermann, Bishoff, Cotta, Gætzschmann and Breithaupt.

In most works on geology the subject of veins is hurriedly passed over, if indeed it be treated at all, and scarcely ever do we find

them ascribing their origin to the proper causes.* Even the famous and lamented De la Beche, in his treatise on theoretical geology, maintains the doctrine that the metallic and other contents of veins are mere secretions from the country rocks through which the veins pass. Were this true, except in a few and entirely exceptional cases, these contents of the veins would necessarily be found to increase in quantity and in frequency of occurrence in the country rocks, the further we should leave the veins. For obviously such portions of the metallic contents of the veins as originally occupied a position near the veins, would be withdrawn from the country and conducted into the vein crevice, while the same substances, at a more remote distance from the fissure, would remain in their original quantity. Entirely the reverse is, however, the case; those minerals which belong to the veins, but which are found in the country, were in reality derived from the former. The vein crevices were the first reservoirs, and the few scattering particles of the minerals of the veins, which we find in the adjacent country rocks, found their way into the latter by elimination or segregation, and by sublimation from the surcharged vein crevice. If the theory admitted by De La Beche were correct, it is evident that those portions of the country most remote from the veins, should be selected for mining operations, as they would, undoubtedly, contain the useful minerals in the most un-

* A marked exception to this rule is the valuable work of d'Aubisson de Voisins and Amedee Burat "Traite de Geognosie," three volumes, Paris 1828, 1834-'5, in the third volume of which we find two hundred and eighty pages from the able pen of Fournet, on the subject of metalliferous deposits. Since the publication of this work, which has deservedly received the most universal praise, many important additions have, however, been made to that branch of the sciences of geognosy and geology which treats of veins, and yet there are few, if indeed any, general works of a later date, which throw as much light on the subject. Among those publications which treat of vein geology and geognosy alone, we find none in our language. Germany has produced the most prominent ones. Among these are Cotta's "Ganglehre" and "Gangstudien," Gætzschmann's "Auf und Untersuchung der Lagerstætten Nutzbarer Mineralien," and Zimmermann's "Wiederausrichtung Verworfener Gænge." Among French works it is proper to particularize Fournet's "Simplification de l'etude d'une certaine classe de filons," and other works by the same author.

diminished quantity. This theory would also render it necessary that a change in the country should always produce a change in the gangue, and yet this is very rarely the case. Where it is noticed, other causes are generally perceptible to which we can ascribe the source of the change observed.

Others have imagined that ordinary metallic veins were of igneous or eruptive origin, although the regular components of the gangues bear no resemblance to igneous rocks of any geological period. This theory scarcely needs a refutation. In those few cases where igneous action is evident, it is always ascribable to the proximity of dykes of igneous rocks.

Some other theories, explanatory of the origin of veins, may be found in a posthumous treatise by the late Von Weissenbach, edited by Professor Reich, and published in the first volume of Cotta's "Gangstudien," (study of veins,) Freiberg, 1850. A pretty literal translation of this article is incorporated, by way of introduction, into Mr. Whitney's "Metallic Wealth of the United States," a work which, despite its deficiences, deserves the credit of being the first real attempt at commencing a mining literature in our country. Such hypotheses as these should rather be regarded, as Cotta wisely remarks, as explaining the different ways in which vein crevices *might have been* filled, than as showing the manner in which they actually *were* filled.

That theory, which is now alone admitted as explaining the origin of veins, and which is the only one capable of uniting the various phenomena connected with the distribution of their constituents, in part much resembles the hypothesis of Werner, although the difference is sufficient to oblige us to designate it as entirely new, and not merely as a perfection of the one propounded by the great neptunist.

Elie de Beaumont, in a treatise on volcanic and metallic emanations, published by the French Geological Society, (2 Series, Tome iv. p. 1249, &c.,) and translated in Cotta's "Gangstudien," (Vol. i. p. 329–517,) remarks that "Werner believed that veins were filled crevices, a fact now universally admitted. He also explained the origin of the substances now occupying the once vacant space of the clefts

as to be found in aqueous solutions which, indeed, seems to be the case with all incrustation veins of bed-like form. He finally considered these waters to have produced surface solutions, which forced their way into the fissures and there formed what we now find in the shape of veins. In regard to the latter point we have abandoned the Wernerian opinion. We admit with him, that the minerals found in veins were precipitated from aqueous solutions, and that these materials have filled the ancient crevices, but we do not view the solutions as having descended from the surface; we regard the minerals constituting the veins as having been derived from the interior of our planet, brought to the surface by mineral waters or by steam, and chiefly occupying the crevices themselves, while the surplus only, which could not find a place in these, distributed itself among the surface waters, whence it was afterwards precipitated." This theory also explains the source from whence metalliferous deposits, like that of copper in the Mansfeldt slates, were derived, for they were the surface deposits of the metalliferous springs, streams and lakes, whose waters were, in part at least, derived from the springs of the veins, or what German miners term "Säuerlinge." It is likewise in accordance with it that Professor Cotta so ably explains the phenomenon of parallelism and concentric repetition of the vein minerals, which is frequently to be seen in such great perfection. He supposes these to have been in one and the same solution, or in a solution periodically replenished from the same or from various sources, and that the minerals were precipitated in succession on the two walls in the order of their solubility, those being first thrown down which required the greatest amount of heat and pressure to render them soluble.

The theory advanced by me, in which the object was to explain the successive appearance of gold, lead and copper, so frequently noticed in a peculiar class of our Southern auriferous veins, and of which more shall be said hereafter, is likewise based upon this opinion regarding the origin of veins.

It is very evident to all who have paid any attention to veins that those causes which produce the filling up of the vein-crevices have, even at our day, not ceased to exist, that changes such as decom-

position, solution and re-precipitation are constantly going on; but it is equally plain that for the production of the grander effects various other important assistant circumstances must have existed, which are now to be detected in their results only. The high temperature and likewise high pressure which must have attended an earlier state of the development of our globe, can alone explain effects, for whose cause we would seek in vain among existing laws unaccompanied by circumstances which gave them greater force.

To the miner it may be of less importance to know that the materials he seeks were derived from a certain source, than it is to be aware that veins are really but filled crevices, and that, consequently, those substances which constitute the veins must have taken possession of their present position at a later period than that in which the rocks, through which they pass, were formed. All veins are younger than the country; and hence it is without any reason, that many writers regard those only as true veins which dip or strike unconformably with the country rocks, (*g* & *f* Pl. I. fig. 1,) for it is evidently quite immaterial what peculiar relative position is occupied by the two as far as concerns the origin or the general character of the veins. Crevices may be formed in any direction, and it is but reasonable, indeed, to suppose that the planes of stratification, being possessed of less adhesion, will, at least, as readily present themselves for the formation of cracks or fractures as those planes which traverse the more compact and less fragile portions of the rocks. These are the bed-veins of the Germans (*d d* Pl. I, fig. 1). Another class comprises the veins of a lenticular character which fill the interstices at the semi-crystalline rhomboidal jointure planes of the talcose slates; they will be more fully treated under the head of the hornstone gold veins. Still another division is that of the contact veins. It embraces those which are found at the contact plane of a dyke of some igneous rock, and the country rock through which it passes. To the miner they are particularly important, as they are almost universally provided with useful minerals, and as their persistency, in workable depths, can be relied upon with greater certainty than with other veins, since causes which may induce other veins to give out, in

many instances, do not exist in these. A contact vein is represented at "*b*" Pl. I. fig. 1.

From what has been already said, it is evident that, by far, the majority of veins are tabular or wedgelike masses with a far more extensive longitudinal than lateral diameter. Irregularities occur as a matter of course. Crevices cannot be expected to follow perfectly true lines, and besides, very frequently after the crevice was formed, but before it was filled, one or the other side, or both, were pressed upwards or downwards, forwards or backwards, and we then find that the vein swells out or narrows beyond or below its usual dimensions. De la Beche has illustrated this by a very simple drawing, which shows that these irregularities were only caused by those parts of the walling which originally fitted into others, being pushed past one another, in whatever direction it may be, (Pl. I, fig. 4.) The lenticular veins are nothing more than these irregularities very strongly developed; the narrow portions have so completely contracted that often no trace exists to show a connection from one to the other, and in some cases they are so far removed from one another that a connection is apparently difficult even to imagine. Fournet has treated this class of veins with great accuracy in his "Simplification de l'etude d'une certaine classe de filons," a pamphlet translated into German under the auspices of Professor Cotta. A section of a shaft-wall in the Funderburk gold mine, in Lancaster District, illustrates this class of veins very perfectly (Plate III, fig. 3). Lenticular veins are also seen in the section of the Brewer mine (Plate III, fig. 1) and at "*a*, *a*, *a*," (Plate I, fig. 1).

Sometimes veins are found in a great mass, striking and dipping in various directions, and traversing a rock in every possible way. This occurrence is termed by the Germans a "Truemmerstock," and the aggregated veins themselves a vein-net (Plate I, fig. 1, *c*). An instance of the kind we find at the famous Brewer's mine, where the rocks traversed by the quartz veins are themselves auriferous hornstone lenticular veins of vast extent.

Certain terms are employed by experienced miners in all countries to denote as well the different parts of veins, as also all irregularities

that may exist in them. Those among them whose use it will be impossible to avoid in this report, I shall explain here.

The rocks, in the crevices of which the veins were formed, are termed the *country* (German *Nebengestein*) (D in Pl. I, fig. 2). The part of a vein, or bed, which shows itself at the surface is the *outcrop*, (German, *Ausbiss ;* French, *tete ;*) its longitudinal course is its *strike ;* (German, *Streichen ;*) its inclination towards the horizon is the *dip*, (German, *Fallen*). The underlying side of the country rock is called the *foot-wall ;* (German, *Liegendes ;* French, *mur-du-filon ;*) ("*i, i*" Pl. I, fig. 2); the overlying side, the *hanging-wall ;* (German, *Hangendes ;* French, *toit ;*) ("*hh,*" Pl. I, fig. 2). The *selvages* (German, *Saalband ;* French, *salbande*) ("*ff,*" Pl. I, fig. 2) are the sides of the vein itself. Sometimes these are separated from the walls of the country by a crevice, which the French term *la lisiere ;* when this is filled, as is generally the case, with clay, shale, talcose slate, (Sutton's mine,) it receives the name of *flockan* or *flookan*, (German, *Besteg, Lettenbesteg*) ("*g,*" Pl. I, fig. 2). When this is all that remains to indicate the continuation of the vein the French call it *trace du filon ;* the Germâns, *Gangbesteg ;* ("*e,*" Pl. I, fig. 2). We have no word for it, but *trace of the vein* might be properly used. *Vuys, voogs* or *opens* (German, *Drusen ;* French *druses, fours, poches a christaux,*) ("*cc,*" Pl. I, fig. 2) are cavities in the veins lined with crystals. A *horse* (German, *Gebirgskeil*), ("*aa,*" Pl. I, fig. 2) is a mass of the country encompassed by branches of the veins, while the latter, which encircle it, are termed *riders*, ("*bb,*" Pl. I, fig. 2). A *dropper*, (German, *Rasenlœfer,*) ("*dd,*" Pl. I, fig. 2,) is a part of the vein which leaves the main body and is lost in the country; while a *leader*, (German, *Trumm,*) ("*ee,*" Pl. I, fig. 1,) is of greater size, shows more connection with the main vein in its strike and dip, and exerts an influence upon the metalliferous contents of the vein. *Slikensides* (German, *Harnische, Rutschflœchen,*) are polished surfaces produced by friction. *Slides, shifts*, (German, *Verwerfungen ;* French, *dislocation ;*) (*E*, Pl. I, fig. 2) are dislocations produced by one extremity of the vein, or both, being moved vertically or horizontally. The point where two veins cross one another, without a shift, is

termed a *tournhouse*, (German, *Gangkreutz*). The *gangue* or *gangue rock*, is the rock which forms the main body of the vein. It is also in reference to its metallic contents, termed *matrix*. A *lode* (*Erzfall* in German)* is that part of the vein which contains the metals, that is to say, it is a portion of the vein with more or less distinctly marked boundaries, having its own dip in addition to the dip of the vein, and being the part which alone contains an important quantity of the ores. Figure 3, on Plate I, shows two lodes as they would appear in a longitudinal section of a vein, "*a*, *b*, *c*," indicating the degrees of purity in the ores, increasing towards the centre of the lode.

There are a variety of other technical terms, employed by miners, which are of less importance, and with the use of which it is easier to dispense.

It is of the utmost importance in mining to know, when a slide occurs, on which side (if the dislocation is in the strike), or whether above or below (if it is in the dip), it is that we should, seek for the dislocated part of the main vein. Zimmermann, in his work on "Die Wiederausrichtung verworfener Gænge, Flœtze und Lager, Darmstadt und Leipsig, 1828," gives a general rule by which this matter can be determined with mathematical precision. To introduce it here would be out of place, as, indeed, it would be unreasonable to imagine it possible that these few pages should give full instructions in dialing and mining engineering.

Sometimes we have double slides or mutual shifts, a fine illustration

* Some writers, among them De la Beche, define the word "lode" as synonymous with that of "vein," and it is, therefore, evident that the term has gradually received a wider application than was originally the case, for I believe that "lode" was first used as "Erzfall" is in German. At all events those few who are acquainted with the existence of such a circumscribed *fall of ore* in veins employ the word "lode" to designate it. Besides it would—even had this application not already been made—be far more advisable to use it for a thing which needs a name and has no other, than for one which has a distinct term, long established, and with which every one is acquainted. As for the word itself it is brief, and has been in long use with miners.

of which is afforded in a little hand specimen from Edgeworth's mine in Chesterfield District, (Pl. I, fig. 5.)

There is no reason to suppose that slides or shifts in veins, or faults in beds, are the results of sudden movements. Indeed, we have the best evidence that it is at least possible for these changes to take place gradually. An instance, which is of itself a sufficient proof, is given by Zimmermann in the work already alluded to, page 135. In a mine in the Burgstætter Revier, near Clausthal, at a depth of five hundred and sixty feet, the country had shifted on jointure planes, which were already in existence, in such a manner that the levels, (tunnels,) as well as the marks of the dialer, were disjointed to a very considerable extent for more than a hundred feet. This interesting occurrence serves also as a proof that slides are not produced by the younger veins along whose planes the shifts occur, (Pl. I, fig. 2,) but that these slides were the result of causes which had their effect prior to the formation of the younger veins. The veins, indeed, are only the substances filling those crevices, that were themselves contingent results of the slide-producing action.

Of scientific interest, not only but of importance too to the miner, are the electric currents which make themselves manifest in metalliferous veins, with regard to which some important experiments have been made by Professor Reich, in Freiberg, and by Fox, in Cornwall. It is but proper, in connection with this, to call attention to a fact which has been noticed by the inhabitants of some mining regions in the United States at all events,* in California as well as the Southern States, although I am not aware that it has, as yet, received the attention of men of science. I allude to the locally well known fact that the electric currents of the atmosphere evidently exert their effects more powerfully in the immediate proximity of a vein than at points further removed from it, consequently the outcrops of these veins

* Very possibly the more powerful effects of atmospheric electricity, for which our country has long acquired a reputation, may enable results of the kind to become evident with us, which elsewhere, owing to greater humidity of the atmosphere, are not sufficiently marked to attract particular attention.

abound in lightning-struck trees, so that indeed some veins may almost be traced by the trees, scarred and lightning blazed.

Of the effects of electric currents upon the metallic contents of veins but little is known as yet. I shall, however, have occasion to return to this subject under the head of gold deposits.

Before closing these introductory remarks it is scarcely out of place to devote a few words to what are termed the indications of the existence of valuable minerals in the lower portions of the veins, as far as these are established by the appearances at the surface. Pretenders to a knowledge of applied geognosy, undoubtedly, seek to let it appear that the surface would, under all circumstances, enable them to prophecy with certainty what may be found below. Although this is not the case to the extent to which they would have it believed, yet experience teaches much which leads to a correct judgment. Thus, for instance, in the talcose hornstone veins of the talcose slates, which to the uninitiated exhibit no apparent difference from the barren slates, it is easy for the experienced gold miner, accustomed to those veins, to distinguish between the auriferous parts and those which are valueless. With equal facility can he separate auriferous gossans (brown ore) from that which contains no gold. With gold there is, however, less necessity for endeavoring to discover what may exist below, than with copper for instance, for the former metal is usually found in greatest abundance in the upper parts of the veins, a fact which has been observed to be the case almost everywhere, where gold *vein* mining has been carried on. The Gold Hill mine in North Carolina, (now about five hundred feet deep and still as profitable as ever) and other mines of the hornstone veins form probably the only exceptions. In seeking for gold the pan is certainly by far the best guide.

As regards copper the quality and quantity of the *gossan* should receive the first attention. This gossan (termed by the Germans *eiserner Hut*, by the Spaniards *colorados*,) is the ferriferous outcrop of a vein, and is ordinarily hydrated peroxide of iron mixed with silicious particles, although often other accessory minerals occur. In Germany this has for centuries been regarded as a necessary part of

a good copper vein. With us these gossans are almost always auriferous, (see gold and copper). The character of the quartz, as regards the persistency of the vein in depth, is also a matter to which it is of the utmost importance to attend, a lively crystalline variety being the most preferable—the very reverse, therefore, of that which is the case with gold.

Lead shows itself, sometimes already in the gossan, in the shape of ores of a secondary character, such as carbonates, phosphates and molybdates (German *Bleimulm*). The character of the quartz is also peculiar, where lead is abundant, and by its younger quartz, with pseudomorphous crystallization, often indicates the original presence of spars.

Very closely connected with this subject is the fact that minerals of the same kind, from different localities, are distinguished by peculiar physionomic features. This is a matter well known to all who have had their attention called to minerals, and is mentioned also by Breithaupt in his "Paragenesis der Mineralien," a German work of deservedly high reputation. Thus gold ores, copper pyrites,* and even gossans and quartz, from different mines, can be very correctly placed according to their origin by one who has once accurately noticed their character. As a matter of course, experience in this matter is of great importance in passing judgment on analagous cases.

These general observations on the formation of veins, the shapes in which they now present themselves, and their physical peculiarities, may, perhaps, appear to occupy too much space in a report, in which brevity should be a prominent object; yet, the subject is one to which, unfortunately, so little attention is generally paid, that they were necessary as an explanation of the main substance of the report. This, it is hoped, they will render intelligible, and at the same time serve to engender that interest in this important branch of geognosy and geology, which it certainly merits, but rarely receives.

* Hence it is that experience teaches us to judge with the utmost certainty in most cases, whether a specimen of copper pyrites is from a mine which will prove productive in depth, or whether it is from one where that mineral is, as it were, a foreign admixture, and where the vein will be found valueless. These differences in the same mineral, though impossible to describe, soon become apparent to an accurate observer.

CHAPTER II.

GENERAL GEOGNOSTIC DESCRIPTION OF CHESTERFIELD, LANCASTER, CHESTER AND YORK DISTRICTS, AND THEIR SPECIAL PETROGRAPHY.

The Maps—Tertiary—Sugar Loaf Mt.—Alluvium—Natural Levee of Catawba—New red Sandstone—Clayslate—Extent—Strike—Metalliferous Veins—Talcose Slate—Extent—King's Mountain Region—Characters—Talcose Slate Sand—Strike and Dip—Metalliferous Contents—Micaslate—Hornblende Slate—Novaculite—Extent of Micaslate—Metalliferous Contents—Itacolumite—Opinions regarding it—Foreign Occurrences—Features—True cause of Flexibility—South Carolina Occurrences—Companion Rocks with us, and in Brazil—Strike and Dip—Specular Schist—Limestone—Igneous Rocks—Granites—Gneiss—Mineral Veins—Rutile—Granite—Syenite—Hanging Rock—Aphanitic Pörphyry—Tufa—Melaphyre—Strike—Decomposition—Diorite and Dioritic Slate—Trachyte—Phonolith—Soapstone—Domite—Eurite and Quartz Porphyry—Strikes—Egeran and Egeran Porphyry—Relative Ages—Mineral Waters and Licks.

THE contents of this chapter relate more especially to the maps, than does any other part of the report. It necessarily also contains petrographic descriptions or definitions, and investigations regarding the different rocks which occur in the four districts surveyed during the past year. The relative position of these rocks is another important subject, which demands our attention here.

The maps indicate the different rocks which occur in the region examined, if we except the tertiary formaticn where it would be impossible to distinguish the occasional clay-beds from the sand or gravel. To those who take an interest in the mineral resources of this section of the State as well as to those, in whose thoughts agriculture occupies the highest position, accurate maps will be of great importance. To the former, they point out where minerals of value may be sought; to the latter, the general features of the soils.

The portion of South Carolina, over which the survey of this year extended, embraces the four Districts (Chesterfield, Lancaster, Chester and York), which stretch westward, along the North Carolina line, and are the commencement of that portion of the State, in which the most

important minerals are to be found. Chesterfield is the only District of these in which the tertiary formation holds a prominent position. The boundary of this formation (for the new red sandstone is too inextensive to attract much attention) is at once the dividing line between a region full of subjects that cannot fail to incite the interest of the miner and technologist, and an extensive division of the State in which there is but little of importance to either, although embracing wide expanses of land, to which the agriculturist deservedly attaches the greatest value. It is the line which separates the Up-country from the Low-country; so that this partition of the State, which makes itself manifest in effects both numerous and varied, is the result of the operation of causes which existed long before the creation of man, and for the comprehension of which geology is the only key.

The *tertiary* formation, as we see it in Chesterfield and in the south-east corner of Lancaster, presents a most dreary aspect—the alluvial deposits along the rivers and smaller streams alone affording a soil which is fully capable of remunerating the labors of the husbandman. Here we, consequently, find many valuable plantations; but the bottom-lands of the streams are usually narrow, and, in addition, especially of late years, very subject to inundations. The tertiary itself of Chesterfield can scarcely be designated as otherwise than one vast region of sand, relieved at distant intervals by outcrops of beds of clay, or by scattering blocks or ledges of a coarse conglomerate or sandstone, the result of the cementation (by oxide of iron) of gravel or sand. Very little of interest is therefore to be found in it, if we except the brown coal, which will be described under the head of useful minerals, and the gold of Westfield creek.

The only subject which merits a moment's attention in the tertiary region, beyond the minerals of practical value, elsewhere treated, is the Sugar Loaf Mountain in central Chesterfield. This singular hill attracts attention, since it rises abruptly, in a perfectly level country, to a height of about a hundred and fifty feet. The problem, which its existence seems to afford, is easily solved, and Mr. Tuomey has already given the explanation in his report. As seen in the section,

Pl. II, fig. 1, it consists of alternating horizontal strata of clay and sand. The former is often of the utmost purity. The sides of the hill are covered by broken blocks of the sandstone, already described, which are also cast about in great confusion over the level lands at its foot. In the section these are marked "*bb*." The top of the hill is crowned by a horizontal block "*c*" which is the remnant of the bed from which "*bb*" were likewise derived, though "*c*" still occupies its original position, "*dce*" having been the original surface. This hill is, therefore, plainly caused by denudation, the remaining portions of the bed having been protected by the ferruginous sandstone.

The *alluvium*, in the part of the State examined, does not occupy an extensive region, being confined to the immediate neighborhood of water-courses. Hence, it may be best spoken of as a note to the tertiary; for it is in the area occupied by that formation that the alluvium most abounds, though, even there, limited in extent. Except as regards its valuable soil-producing qualities, of which more will be said in the fourth chapter, there is little concerning it which can render it of importance. The geognostic disposition of the beds is usually as unimportant as the minerals they contain. The only interesting case is figured in Pl. I, fig. 7 and 8. In the former we have a section, in the latter a view of a singular natural embankment or levee of the Catawba river, on the land of Thomas Whiteside, Esq., in York. In fig. 7, "*a*" is the river, "*b*" the first terrass, "*c*" the levee, "*d*" the strata of sand at the top, "*e*" the back-water bottom-land, "*f*" its bed, "*g*" the rising hills. The embankment rises twenty-five feet on the river side and eight feet on the land side, with a regularity and evenness which would do credit to a railroad. In fig. 8 we have an outline view. In it "*aa*" is the distant river bank, "*bb*" the level surface of the rampart, "*ccc*" its inside slope, "*dd*" the back-water land, "*e*" the rising ground of the hills, "*f*" a high hill on the Lancaster side of the river, and "*g*" the entrance of the back-water. The top of the embankment is cultivated as well as the back-water land. At present the river is not known to rise to the surface of the bank.

The *new red sandstone* formation reaches from North Carolina but

a short distance into Chesterfield. We find it in the neighborhood of Hornsboro' extending westward about a mile along Clay creek, southward one mile from the line to the farm of Mr. Joel Brewer, Sr., and eastward in two bodies overlying the clay slate of Thompson's creek, for about three miles. On the land of Mr. Ephraim Horn, near Hornsboro', we find the sandstone best adapted for architectural purposes. It is used for chimneys in that village, and resembles the sandstone used for the cathedral in Charleston. Coarse conglomerates also constitute a portion of this formation or geological division in our State. Both these and the sandstone are distinguished from the same rocks of the tertiary by the fact, that the coloring matter (oxide of iron) has, in the former, entered into the interior of the cemented parts, which is not the case in the tertiary rocks. The color is also of a brighter red.

The only distant approach to coal which I found here, was a small extent of bituminous shale with spheroidal exfoliations.

Thus far we have been obliged to deal with entire formations or geological subdivisions, though the rocks, which belong to them, may differ locally from one another; for it would obviously have been impossible to indicate on the map where a bed of tertiary clay crops out, or where the sandstone of the new red passes into a conglomerate. In the rest of the chapter the older stratified rocks and those of igneous origin will be the subjects to receive our attention. The former in regard to their relative position, commencing with the uppermost, are:

Limestone, Itacolumite, Specular Schist,	Clayslate.
Talcose Slate, Mica Slate,	Hornblende Slate.

The relative position of the clayslate (with the exception of that found between the limestones) to the limestone and itacolumite it is impossible to determine, as the whole width of Lancaster and York

separates the main body of the former from the two lätter. The relative position of the hornblendic slate of Hanging Rock creek to the talcose and micaceous slate, it is also impossible to establish, as they do not there come in contact with one another.

In the description of these rocks it will be most convenient to adopt a geographical division, and to commence with the *clayslate* of Chesterfield and south-eastern Lancaster.

This rock, of which Mr. Tuomey intimates the possibility of its belonging to the paleozoic system, appears whenever the tertiary deposits have been removed by the rivers and smaller streams. We thus find it in the bed of the Peedee just above the falls at Cheraw, on Westfield's and Thompson's creeks, the head waters of Bear creek, on Lynch's creek, and thence trending west along the strip of talcose slate in the south-east corner of Lancaster. Where this argillaceous schist approaches the talcose slate, with which it dips unconformably, we find it becoming talcose in its composition, while its strata on Bear creek and the Peedee are arenaceous and micaceous. Its color when undecomposed is usually grey or brown. In its decomposed state it is ordinarily yellowish, sometimes varied by darker stripes, which at the bridge over Thompson's creek, on the road from Chesterfield Court House to Cheraw, present a variety of minute faults, from which choice and instructive specimens may be gathered. The strike of this rock in the bed of Thompson's creek, two miles from Hornsboro', is N. 53½° E. At Hornsboro' the strike is N. 44½° E. the dip both N. and S. East of this the strike is N. 56° E. At the Slateford of Lynch's creek the strike is N. 89° E., the dip 10° to 17° N. 1° W. At Mr. Todd's, near the Gay Mine in Lancaster, the strike is N. 44° E., the dip 45° S. 46° E. The strike of the rock near the Peedee falls is N. 44° E., and the dip to the N.W. but very slight. It is only exposed here for about four hundred feet, the water being deep above and below. At the Hendrix Mine, in Chesterfield, the strike is N., the dip 11° E., afterwards becoming nearly vertical. On Moore's mill prong of Bear creek the strike is N. 39° E. The arenaceous bed at Mr. Blue's plantation, north of Cheraw, strikes N. 41° E.

The most important mine situated in the clay slate is the Brewer & Edgeworth Mine in Chesterfield, but the Hendrix and the Kirkley Mines, also in that district, should not be forgotten; nor should the vein on Mr. Rivers' land, (striking N. 71° E., dip vertical, four feet wide,) as it will certainly prove cupriferous. A small dropper near the Slateford, connected with a main vein on the Chesterfield side of Lynch's creek, though itself on the Lancaster side, contained copper, and gives additional proof that the cupriferous veins extend into this rock, as indeed a leader of one of them, at the Brewer & Edgeworth Mine, does into the new red sandstone, a matter of importance in estimating the relative age of these veins.

The main body of the clay slate lies to the east of the granitic and syenitic dyke of Taxehaw and Chesterfield, though a narrow strip of this rock extends to the west of the dyke in the north-western part of Chesterfield.

The *talcose* slate is the next stratified rock that we meet in our progress westward. It embraces several disconnected bodies, which are mostly separated from one another by granitic rocks. The principal of these distinct areas extends along the North Carolina line from Hill's creek in Chesterfield to the vicinity of Jacksonham in Lancaster. Hence it stretches between the granite of the Waxhaws and the granitic and syenitic dyke of Taxehaw over the main portion of Lancaster, from which district it passes into Chester, terminating about two miles east of the Charlotte and South Carolina Railroad on Mr. McWilliam's farm. Here it touches the gneiss of west Chester, while to the north and south it is bounded by mica slate, the result apparently of a contact metamorphosis. From this body of the talcose slate the great syenitic dyke of southern Lancaster and Chesterfield has severed that strip in which we find the Brewer and the Hale Mines. A lobe-shaped portion of the talcose slate extends from the north-eastern corner of Lancaster, north of the Waxhaw granite, crossing the Catawba above, near the Nation ford, and below near Cureton's ferry, and terminating near Mr. Pride's plantation in Chester. This is the only talcose slate we meet with in York, until we strike the eastern slope of King's mountain in the north-western part of the District.

The talcose slate of King's Mountain forms a somewhat wedge-shaped belt which widens as it nears Broad river. It overlies the mica slate of the high ridge of King's Mountain and of Buffalo creek, and underlies the itacolumite, being separated from this rock, however, in most cases, by a coarse felspathic bed, a stratum of hornblendic slate and one of a micaceous character, which recur in regular succession wherever the present level of the surface, indicated by a dotted line on plate V, admits of their exposure. Their thickness is never great, rarely exceeding fifty feet in the aggregate, and often not even fifteen. On the section, to be able to exhibit them at all, it was necessary to exaggerate their size. The specular schist (and itabirite) lies between these and the talcose slate, sometimes replacing them in part, where it widens beyond its average bulk. This rock, though highly interesting in carrying out the comparison of itacolumite rocks of our State with those of other localities, and moreover of technical importance, has on the section been indicated only by a line where it is mined as an iron ore, partly because its thickness is remarkably variable, partly because the most noticeable occurrences are at the points where it is worked. This rock is fully treated under the head of iron ores.

Having thus introduced a sketch of the rocks of the King's Mountain series, it will be most advisable to complete it here.*

The itacolumite, or rather the main body of this rock, is overlaid by a narrow stratum of talcose slate, which, near Mr. Thomas P. Black's, between the two most prominent limestone out-crops, passes into clayslate. In this edition Plate V. has been corrected according to the results of the latest observations.

The talcose slate exhibits but little difference in its character at

* A. Harding, Esq., has, at my request, made an accurate geodetical survey of this region. The results arrived, however, too late to be incorporated in this report. That survey will be probably continued into Spartanburgh, and it will therefore be most advisable to present the results of the work entire, and introduce Mr. Harding's report on the measurements of the whole itacolumite region of South Carolina, when discussing the geognosy of Spartanburgh. For a more perfect account of this region, see my 2nd report and "The Itacolumite and its Associates," now about to be published.

different points. We may, however, particularize a singularly spotted variety occurring on King's Mountain, near Mr. Wells', where black or grey stains are seen crossing the cleavage planes at an angle of 45°. The other parts of the rock are whitish. The talcose slate of the Huey Mine in North Carolina, which also appears near Morrow's in Lancaster, is black. The slate at the Blackman Mine is translucent and of a silvery grey, fawn or pea-green color. Otherwise the slate shows itself generally in a decomposed shape, and in that case the color is generally of a pale reddish cast. At Caveny's on King's Mountain, a greenish variety is quarried for tombstones.

The sand of the talcose slate regions is generally a substantial proof of the existence of that rock beneath. It is exceedingly fine grained and packs very closely. A very perfect evidence of the latter was afforded in cleaning a spring for the use of the camp. At a depth of six inches below the bed of the stream, issuing from the spring, the sand was as dry as ashes, showing that the water never penetrated to that depth. This affords an explanation of the serious effects produced by drought in those parts of the country where the talcose slate is the underlying rock.

The strike and dip of the talcose slate I found:

On Tinker's creek in Chester,......	strike N. 37° E. dip vertical.
(Chloritic) Indian lands, York,.....	strike N. 50° E. dip S. 40° E.
Shelby road, near King's Mt., York,	strike N. dip E.
McCosh's store, north-west York,...	strike N. 86° W.
Mrs. Gunthorpe's, north-west York,	strike N. 75° E.
Morrow's north-west Lancaster,......	strike N. 55° E.
Morrow's north-west Lancaster,.......	strike N. 56° E.
Brother Belks' Mine, Lancaster,.....	strike N. 50° E. dip N. 40° W.
Blackman's Mine, Lancaster,.........	strike N. 77½–80° E. dip N. 58°.
Hale Mine, Lancaster,.................	strike N. 65° E.
Hale Mine, Lancaster,.................	strike N. 75½° E. dip N. 14½° W. 53½°.
Brewer's Mine, Chesterfield,.........	strike N. 70–72° E. dip N. 18–20° W.

As a metalliferous country rock the talcose slate occupies, with us,

a most prominent position, and in reference to gold, at least as far as I have yet been able to observe, it stands highest in the scale. With regard to the occurrences of metals in this rock, or in its veins, their distribution is very decidedly influenced by the neighborhood of the igneous rocks, especially the newer and coarse grained granitic dyke of Taxahaw. On either side of this we find gold mines strung along; on the south the Brewer, Leach, Hale and Gay Mines; on the north the Funderburk, Knight, Johnston, Blackman, Phiffer, Little Blackman and Redding Mines. The Izell and Pott's Mine seem to derive their metallic contents from the Waxhaw granite, while other metallic veins of Lancaster, as the Belks' veins and that of Mr. Stroud, may be influenced by the trachytic dyke. On the other hand the gold, in the veins of which north-western York abounds (though much of the branch deposit gold found there may be ascribed to the stratified rocks—itacolumite, specular schist, etc.—which in other localities are themselves auriferous), may have its origin in the melaphyre dykes, although the distance downwards to the granite, which appears to the east, is, comparatively speaking, probably not very great. This influence of igneous rocks upon the metallic contents of the veins in neighboring country rocks has frequently been observed elsewhere, and the instances mentioned here are but an inconsiderable addition to a long list of similar observations.*

Among the metamorphic rocks, next to the talcose slate, the *micaceous schist* extends farthest to the east; if we except the *hornblendic slate* which—with the exception of isolated beds in the micaceous or talcose slate regions, like the *novaculite* also between Bell Air and Lancaster C. H.—appears only in the granite of Hanging Rock creek, whence it extends S. 80° W. (dip S. 10° E. 45°) to the Catawba, everywhere penetrated and divided by granitic ramifications.

The mica slate appears generally between the talcose slate and the granitic rocks. This we find to be the case in Chester and in western York. A large body, however, in which no true talcose

* Interesting in this respect are the seams in the granite at one of the quarries near Columbia, opened for the new State House. On the faces of these we find small and scattering particles of iron pyrites, copper pyrites and sulphuret of molybdenum.

slate shows itself, is seen in central York, and a small extent of it at Henry's Knob, while in the extreme north-west corner of York we meet with this slate, containing interstratifications of the coarse felspathic or gneissoid rock already mentioned. On King's Mountain we also find mica slate crowning the ridge in South Carolina.

Near Mr. Pride's in Chester, on Tinker's creek, we find a description of silicious mica slate, suitable for coarse whetstones for scythes, etc. and striking N. 35° E.

As a country rock for metalliferous veins, the mica slate deserves much attention. As York is, however, the only one of the four Districts where the mica slate occupies an extended area, we meet with important veins in it in that District only. These are the veins of the Mary, Wilson, Wiley, Smith's, Martin and Dover Mines.

Thus far the rocks which have attracted our attention, were more or less distributed over the four Districts, but now we must deal with some which are confined to the north-west corner of York. The *itacolumite* is most conspicuous among these.

Before speaking of the occurrence and area of this interesting rock in our State, it will be proper to enter into some observations on its characteristics and peculiarities, especially as a great diversity of opinion exists among geologists as to the exact position which it should hold in petrographic classification. It is a rock of comparatively rare occurrence, and hence but few geologists have been able to study it in its original localities. In addition to this the names of elastic sandstone and flexible quartz rock, or the German one "Gelenkquartz" (jointed quartz), which have been given to it, although descriptive only of features but rarely occurring, have undoubtedly tended to make an accurate definition less perfect, especially as it would seem that the causes of this flexibility have not been generally understood, and that it has consequently been ascribed to untrue ones. My opinion is based on the observations I have been able to make in our State, in making which, I certainly found the greatest inducement to proceed with accuracy owing to a conversation on this subject, which it was my good fortune to enjoy some years ago with the illustrious Humboldt.

Walchner, a German geologist, in his work on geognosy (2d edit. vol. 1, p. 38) describes the itacolumite under the head of talcose slate; and Mr. Tuomey, in his geological report of our State, terms it simply quartz rock; while Cotta, in his work on petrology, mentions it among the rocks resulting from the destruction of pre-existing ones, although, in this instance, he evidently speaks only of that portion of the itacolumite which has given rise to the names of elastic sandstone and flexible quartz rock.

This rock, in South Carolina, crosses the north-western corner of York District, and then extends into Spartanburgh in a regular strike of about S. 45° W., varying from the main course but slightly and only locally. Humboldt described it as forming the mountain itacolumi in the Brazils, and Eschwege traced it there for about five hundred miles,* while Helmersen and Hofmann observed it extensively in the Southern Ural.† In all these far distant localities it is the same—a compound rock, consisting of quartzose grains intimately mixed with particles of talc and sometimes of mica. It is highly schistose in its structure and, were it not for this, might with propriety be regarded as a variety of the greisen or hyalomict granite for which Humboldt says it was originally taken. From simple lydite or schistose quartzite it differs too much on the one hand, and from talcose or micaceous slate too much on the other, to be regarded as a subdivision of either. It possesses moreover all the characteristics —bulk and regularity of composition—which should entitle it to be considered as a separate and distinct rock; and its difference from either of the two rocks above mentioned is greater than that, which has been found sufficient to separate eurite from granite, or mica slate from truly stratified gneiss. It contains quartz, as many other rocks do, without being quartz rock, and talc, likewise a constituent of numerous rocks which cannot, for that reason only, be termed tálcose slates.

In South America, as well as with us, the localities where the flexible specimens may be obtained are very sparingly distributed, but

* Cotta's Gesteinslehre (petrology) Freiberg, 1855, p. 212. † Ibid.

the same beds extend onwards without any perceptible change in composition, although they lose their elasticity. In York I discovered none that exhibited this peculiarity, but it would be obviously absurd to admit this difference as a distinction between the rock in York and that which, in Spartanburgh, exhibits this character so perfectly, when we can without interruption trace the beds from one to the other District.

This flexibility has been hitherto ascribed to a peculiar stage of disaggregation or even disintegration accompanied by decomposition, a stage intermediate between the compact and the friable state; but as far as my observations extend (confined it is true to but one of the three known great occurrences) there is no very conspicuous difference in decomposition to be noticed. The greater or less friability is ascribable to a corresponding amount of attrition, and consequently disintegrating (not decomposing) action, but this exerts no influence upon the flexibility. In comparing the flexible parts of the itacolumite with the inflexible, it will be perceived that the former always possesses an infinitely finer grain than the latter, so that the grains of quartz are more completely encompassed by talcose matter, which, being of itself elastic, imparts to the rock, of which it is a constituent, this feature also. In the coarse rock on the other hand, the quartz as well as the talc, is larger in grain, and consequently the quartz, which in both is the more predominant of the two minerals, is not so well enveloped by the talc, and the particles of talc themselves are less flexible. The necessary result is a slighter degree or utter want of elasticity in the rock, which becomes more friable, and crumbles to a coarse sand when we attempt to bend it. This elasticity, then, is simply due to the fineness of grain and the isolation of the quartz grains by talc, and is therefore an abnormal feature rather than a regularly distinctive one. We consequently find the rock in every stage of flexibility. The fact that Eschwege traced it over so great a distance in South America, proves that he too included the whole as one rock, and that he did not allude to those local varieties only which chance to exhibit remarkable, but certainly irregular, peculiarities. Humboldt terms it both itacolumite and chlo-

ritic quartz, and makes no distinction in name between the pliable and inflexible parts.

Most geologists have been able to study this rock from hand specimens only, and these were, as might be expected, selected from that portion which most strongly exhibited the singularity found with this rock only, although but exceptionally even with it. From these remarks it would certainly appear that the term *itacolumite* should be accepted, derived as it is from the name of the locality where the rock was first seen and studied, and hence concisely descriptive of its chief occurrence, and sanctioned moreover by the use of Humboldt; in preference to names which are fully applicable only to specimens, that are not characteristic of the ordinary features of the rock; and still more to those which apply also to rocks entirely distinct from it, or such as, by a combination of words, are descriptive of its characters, but imply a subdivision of another rock (like von Eschwege's name of chloritic quartz), from which it is sufficiently distinct in character to be separated in nomenclature likewise.

In York, as well as in Spartanburgh District, as has already been remarked, this rock is strongly schistose in structure. Commonly it may, with ease, be broken into flat slabs, which greatly facilitates the obtaining of choice specimens where it is flexible; but I have also found it contorted or in folds, so that specimens, illustrative of this fact, frequently resemble silicified wood, the planes traversing it corresponding, when seen on end, to those which mark the annual growth of trees. The laminæ are parallel to the stratification.

In our State the itacolumite is peculiarly interesting and important, as it proves, in that region at least in which I have as yet only examined it, to be the immediate underlying rock of the limestone. As on this account it is of considerable practical importance, and as, from its connection with the diamond in the Brazils, it naturally excites much interest, I have accompanied this report by a section exhibiting its position, in which, at all observable points, the angles of dip of the various rocks were taken with care, and the ideal prolongation of the strata made in accordance. A more complete description of this section, which traverses a space of eight miles,

will be found under the head of the King's Mountain group (see talcose slate). Nevertheless, it would be improper to omit or postpone calling attention here to the singular coincidence in the details of the occurrence of this rock with us and in the Brazils, as we find it accurately detailed in Humboldt's "Essai géognostique sur le Gisement des Roches dans les deux Hemispheres, 2nd edit., Paris, 1826," p. 88–93. It occurs in South America in alternation with beds of chloritic slate, auriferous quartz and auriferous specular schist, while at Serro do Frio the clay slate, which in the Brazils underlies the itacolumite, supports a bed of limestone. With us we also find, in intimate connection with the itacolumite—limestone, talcose (sometimes chloritic) slate, specular schist, (affording the iron ores of the limestone region,) and, underlying all, the micaceous schist, which corresponds with the same rock in the same position in the Brazils. Between the mica slate and the itacolumite, we find clay slate in South America and talcose slate with us, although in one instance, between the Harding and Bird quarries, I found a slate of a more argillaceous character. The itacolumite itself in one instance (see section) passes into phtanite, while auriferous saccharoid quartz veins and auriferous stream deposits, of greater or less value, abound throughout the whole region, and thus give rise to greater similarity with the Brazilian occurrence.*

* As the work of Humboldt here alluded to is now out of print, it may not be uninteresting to some readers to add a few extracts here, regarding the occurrence in South America; for it is not unreasonable to hope that future discoveries may add to the importance of this rock. "Cette formation quarzeuse (l' itacolumite) renferme des couches alternantes, 1. de quartz aurifere blanc, ou verdatre, ou rubane, mele de talc-chlorite en offrant des stratos de quarz flexible, que l' on a faussement attribuees jusquici a l' hyalomicte (greisen), *ou a des couches de quartz dans le micaschiste;* 2. de chlorite schisteuse; 3. de quartz aurifere, mele de tourmaline (Schorlschiefer de Freisleben); 4. de fer oligiste metalloide, mele de quarz aurifere (goldhaltiger Eisenglimmer Schiefer, specular schist). Les couches de quarz chloriteux out jusqu a 1000 pieds d' epaisseur. Toute cette formation est couverte d' une breche ferrugineuse extremement aurifere. C' est a la destruction des couches que nous venons de nommer, et qui soit liees geognostiquement les unes aux autres, que M. d' Eschwege croit pouvoir attribuer les terrains de lavage qui renferment a la fois

The strike and dip of the itacolumite near the ferriferous bed, worked by the King's Mountain Iron Manufacturing Company, is N. 20° E. and 45° N. 70° W. On Whitaker's ridge the strike is N. 44° E., the dip N. 46° W. 45°. On the Cherokee road the strike was found to be at different points N. 45° E. and N. 36° E.

Immediately below the itacolumite we find the *specular schist* and its variations. These will be spoken of among the iron ores. The *limestone* is found, as already stated, above the itacolumite. This also is included in the chapter on useful minerals.

Leaving the stratified rocks, we must now turn our attention to those of *igneous* origin, which, on account of the influence they exert upon metalliferous veins, their extensive occurrence and their importance as soil-producing rocks, are among the most interesting of all.

The igneous or eruptive rocks of these Districts may be thus classified according to age, commencing with the newest:

Eurite and Quartz Porphyry (?)
Trachytic rocks:—Coarse trachyte of eastern Lancaster.
Domite, Phonolith.
Trappean rocks:—Diorite and Diorite Slate, Soapstone (?) Talcose Trap (?)
Melaphyre.
Aphanitic porphyry.
Granites:—Coarse grained granite, &c., of Taxahaw, (syenite.)
Other Granite and Gneiss.

The marks of interrogation with some of these denote that their exact relative position is not fully established.

These rocks it will be most convenient to take in the order of their importance, and not according to their geological age.

l' or, le platine, le palladium et les diamans." *Humboldt, Gisements des Roches*, p. 89. "Sans etre composee de couches alternantes elle (l' itacolumite ou le quartz de Minas-Geraes) n' offre qu' une seule masse de quartz entrelace avec du fer speculaire granulaire ou dense" (massive specular iron). Ibid, p. 89. "Un thonschiefer (clay slate) du meme age que celui, sur lequel est superpose les quartz chloriteux, renferme (Serro do Frio, pres de S. Antonio Pereira) un banc de calcaire primitif." Ibid, p. 91.

The *granites* certainly occupy the most territory of all the igneous rocks. One or more of these is seen in every one of the four Districts. A *gneissoid* rock, which passes into true granite, and is itself an igneous rock, is found in York and Chester, though infinitely more abundant in the latter District. It rarely shows itself at the surface, and is only exposed in the beds of streams. An abundance of quartzose veins occurs in it, some of which, on account of the quantity of iron pyrites which they contain, and the quality of the gangue, seem to point to cupriferous contents below. Such veins were observed at numerous places both in eastern and western Chester. In the quartz of one of these veins on the land of Mr. Hardin, six miles west of Chesterville, I found rutile. Galena is also said to have occurred there. No mining explorations of any of these veins have been made, and their future character remains therefore to be decided. The discoveries of gold, which were last year supposed to have been made in Chester, and where, at the time, I was unable to detect any of the metal, have since been sufficiently contradicted. At Sutton's Mine, in York, the country is gneiss.

The gneiss passes gradually into a fine-grained *granite*. Of this a very perfect illustration is seen in the gneiss of Tinker's creek, (St. N. 70° E. *d.* 74° N. 20° W.,) which is quarried for sills and door-steps. The granite appears close to this in strongly marked characters with bold outliers. Similar ones we find in northern York between Henry's Knob and King's Mountain, and between Wiley's Store and Yorkville. Such outliers also occur east of Sutton's Mine in north-eastern York and in the Waxhaws and the south-west corner of Lancaster. All these granites are of a fine grain and a gray color, and differ altogether from the following. The granite I have not found to contain any metalliferous veins itself, though contact veins exist which deserve notice, and an abundance of others appear in its immediate vicinity in other rocks.

The great *syenite* dyke is seen at Taxahaw, in Lancaster, extending thence north-east to the Brewer and Edgeworth Mine in Chesterfield, (whence it disappears to rise to the surface again in North Carolina,) and south-west to Hanging Rock, and probably also to Winnsboro'.

It is universally characterized by a very coarse grain and a porphyroid distribution of the felspathic crystals. Although the presence of hornblende is not universal, it has been particularized as the syenitic dyke, because in it alone does syenite occur.

This coarse-grained granite is newer than the gneisses and fine-grained granites of Chester and York, though at Cedar Shoals, in the edge of Kershaw, a dyke of a fine-grained granite appears in it. Lenticular or globular masses (perhaps lenticular dykes, geodes), of a similar fine-grained granite, are frequently met with at the great Rock House outcrop near Taxahaw. At this singular and extensive mass of bold outliers we find a most instructive instance of the boulder-like outcrops of this rock. A more admirable illustration could scarcely be met with anywhere. Scattered in wild profusion they topple over one another in every direction. Some single blocks rise to a height of fifty feet, while others form cool grottoes. Not far from this is Terril's quarry, where the bare rock covers many acres, a straggling cedar only at distant intervals, somewhat relieving the uniformity of the view. Here we find some singular caverns produced by the action of water in ages past.

At the two places just mentioned the rock is a true syenite, very beautiful in appearance, though, owing to the size of the felspar crystals, ill adapted to mill-stones. The black hornblende, pink felspar and bluish quartz, produce a mixture of colors very pleasing to the eye, and remind us of the Quincy granite (more properly, syenite). The same characters belong to the rock of the Sumter quarry, but at Hanging Rock—noted more for the battle fought there than any great natural peculiarity—the hornblende is gradually replaced by mica. The same change is noticed north-east of Taxahaw; for in Chesterfield, we find scarcely any syenite, and near Stone House creek, the rock is altogether true granite. The syenitic character is therefore probably owing to the trachytic dyke and the melaphyre.

The influence, which this dyke has had upon the metalliferous contents of the adjoining talcose slate, has already been stated, when speaking of the latter.

Next to the granitic rocks the *aphanitic porphyries* cover the most

space. They are found most extensively in Chester, where the main body, though of less total width, is also less severed into minor dykes than in York. Another smaller succession of dykes reaches from the Waxhaws to Rossville. In their color and appearance these porphyries present a considerable variety. They are usually dark; sometimes distinguishable crystals of hornblende appear, but ordinarily this mineral is intimately mixed with the felspathic base or matrix. Some are admirably adapted for building materials.

The soils, which these rocks yield, are possessed of high qualities, though the impervious clay beneath may frequently lessen their apparent value.

At Chesterville a calcarious tufa forms in crevices of the decomposed rock and in ditches, the lime being derived from the hornblende. Singular arc-shaped quartz veins are seen here (Pl. I, fig. 9). Quartzose knobs show themselves at numerous points, but no minerals of value occur in connection with them. Magnetic iron is occasionally found in considerable quantity in these porphyries (see iron). The strike of these dykes is north-east, as shown on the map.

Next in extent is the *melaphyre* or aphanite, a black rock which is usually of a close grain and great toughness. It scarcely differs from the porphyry, except in fineness of grain. The term melaphyre has become somewhat indefinite of late, but still it would seem the most proper one to apply to this rock. Spheroidal exfoliation is not uncommon, and is sometimes seen in great perfection, as on Pl. IV, fig. 6, sketched from a rock on the road near Flint Hill Church in north-eastern York.

This rock occurs in all the four Districts, though apparently confined to eruptions, which generally left the porphyries unmolested. The map sufficiently indicates the dykes. In strike these differ very materially, though most are N. E. Of those striking N. W. we have several instances also. Thus, between King's creek and the Morgan Mine, a dyke strikes N. 25° W., another at the Izell Mine is N. 28° W., while a third at the Hale Mine has a strike of N. 35° W. These are instances taken from the most different parts of the region. Some dykes are also found with a due north strike, as

on Six-Mile creek in eastern York* and south of Bell Air in Lancaster.

The melaphyre is younger than the aphanitic porphyry. We shall, however, have occasion to return to the subject of the relative ages of the igneous rocks.

When the melaphyre decomposes, it forms a yellow clay of great tenacity. This change is, however, gradual, and consequently produces apparent differences in the soil, without their being actually any variety. Fig. 6, on Pl. IV, shows this gradual change. In it "A A" is the undecomposed, black rock, "B B" the portion in the first stage of decomposition, where the mixture of the yellow clay with undecomposed parts of the black rock produces a green color. "D D" is the fully decomposed rock of a yellow color, in which are found "C C" darker parts, still containing a few undecomposed particles. (See agricultural.)

Dioritic dykes, if we include the *dioritic slate*, are the next in extent. We find them scattered over various parts of York, Chester and Lancaster, although in comparatively few instances only of a sufficient size to permit their notice on the map. The diorite is newer than the melaphyre, and consequently younger also than the aphanite. The dioritic slate shows itself in northern Lancaster, where it forms the commencement of a dioritic region, which in North Carolina is the country rock of various auro-cupriferous veins. Those of the Vanderburg and Phœnix are among them. In our own State I have found none in this rock. The diorite is one of those rocks which produce the soil termed in Chester and Lancaster the "black-jack soil." (See agricultural.)

The coarse grained *trachytic rock* of Eastern Lancaster and Chesterfield is probably the next most extensive. It shows itself most prominently in a long serpentine dyke in east Lancaster, which extends from the North Carolina line, near Plyler's, to the verge of the tertiary. Another is seen crossing Lynch's creek at the edge of the granite just above Brewer's Mine. This rock, like the following, is

* In the present edition I have availed myself of the opportunity afforded by a second publication, to correct the dykes in western Chester and York.

not of sufficient extent to attract any other than scientific interest, though its influence upon the metalliferous contents of the talcose slate seems apparent.

Phonolith is seen in Chester at several places, though no where extensively. The rock is characterized by its white surface, when decomposing, and by the ringing sound it emits when struck by the hammer (whence its name). It is frequently of a stratiform character, as on Fishing creek. A porphyroid nature is also not uncommon. A dyke of this description is seen, striking N. 45° W., on the old Saluda road, two miles north of Chesterville. A melaphyre dyke, west of the granite in Chesterfield, passes also into phonolith.

Soapstone shows itself in some parts of York and Chester. The larger dykes are usually impure, and often form a species of porphyry in which the imbedded crystals are hornblende. When the grain of this is fine, it is termed talcose or chloritic trap. At the Nation ford of the Catawba in York, and immediately north of Chesterville, soapstone of a fine quality is quarried.

Domite I have found only in Lancaster, at Dobey's bridge and near the dioritic slate. It is a white trachytic rock, sometimes porphyroid.

Eurite and *quartz porphyry*, the latter being only a coarser variety of the former, is found most frequently in Chester, often, when of a finer grain, producing by decomposition a powder which, for polishing purposes, rivals the infusorial slate of Bilin. A dyke of this rock occurs north of Chesterville, and another, towards its western extremity becoming an almost pure quartzite, forms Price's mountain. Numerous smaller dykes are constantly seen in the porphyry region.

The strike of these dykes is exceedingly variable. The following is a list of some in York and Chester:

York.—South of McConnor's Station on the York Railroad, N. 70° W. Four miles S. E. of Crosby's store on the Chester road, N. 80° E.

At Hemphill's S. of Bullock's creek, crossing the road, (small dykes,) N. 40° E., N. 8° E., N. 30° E., N. 45° E., N. 17° E., N. 22° E.

Between Wylie's store and Yorkville, 3 miles west of the village, N. 60° E., N. 12° E., N. 5° W.

Chester.—East of Chester village, 8 miles, N. 45° W.

East of Chester village, 5 miles, N. 15° E.

North-east of Chester village, 1½ miles, N. 57° W.

West of Chester village, 3 miles, N. 50° E.

South-east of Chester village, 6 miles, N. 35° W.

South-west of Chester village, 9 miles, on Dr. Mobley's land (White Stone Lick) a continuation of the phtanitic quartzose rock of Price's mountain, N. 80° W.

Although it is not possible in all cases positively to establish the relative ages of these rocks, still in several instances we find the respective positions, occupied by the most of them, clearly defined. Cases, which prove the melaphyre to be younger than the aphanite, the diorite newer than the melaphyre, and the quartz porphyry more recent than the diorite, are common. A very fine illustration, a section, has been represented in fig. 2, Pl. IV, where, in a melaphyre dyke, "A A A," traversing granite, a number of small dioritic dykes (B B B) occur, themselves again traversed by euritic dykes (C C C), which have sometimes caused slides. This occurrence is on the land of Mr. Ferguson in east Chester. At E. Walker's mill on Sandy river, west of Chesterville, we find a melaphyre dyke in the aphanitic porphyry in which small dykes of a younger porphyry occur. Minute dykes of a chloritic granite traverse this again, while all are divided by new, unfilled fissures. A ground plan of this is shown on Pl. IV, fig. 1, which, in its variety of older and younger veins, slides, cross-courses and vein knots, affords a very interesting subject of investigation. In the figure the shaded part "A A" represents the melaphyre, the white "B B" the younger aphanitic porphyry (the only instance I have seen where some of this rock is newer than the melaphyre), the black lines "C C" the chloritic granite, and the dotted lines "D D" the unfilled fissures, which are of very recent date. Such clefts are, even now, frequently produced by the expansive effects of solar heat, in consequence of which occasionally large masses are blasted or rather blistered off with a report resembling that of a cannon. At "*d*" we see a well-developed tourn-

house, while "*g g*" are very distinct horses, "*f f*" and "*a*" slides, and "*b*" a slide where the newer dyke is apparently dislocated by the older one.

Before bringing this chapter to a close, it will be proper to make some mention of mineral springs and licks.

Chalybeate waters are the most common. Resulting from the decomposition of iron pyrites, we find springs of this description almost everywhere, where iron pyrites are abundant. The most important of these is at Capt. Ingram's, in Lancaster, where accommodations have recently been made for the reception of guests. The spring is of the most icy coldness, which, added to its strength as a chalybeate and saline spring, had long established its name in the neighborhood. Other springs of somewhat varying qualities occur close to it.

An exceedingly small amount of saline matter in a clay seems to be sufficient to give rise to licks. Many of these were at first the resort of buffaloes, though now scarcely visited by deer even. Saline excrescences of the soil I noticed in the King's Mountain region. The salt, which is almost pure chloride of sodium, exudes after rains. A saline (brackish) spring occurs not far off.

The water of the dioritic and aphanitic rocks generally contains mineral substances in solution, which render it exceedingly unpleasant to the taste. This is especially the case with the water of Chesterville. Lime is one of the prominent ingredients. Accurate analysis can, however, alone fully establish their character, and these, limited time and want of assistance in the labors of the survey have made impossible for the present. There are a number of other waters which would likewise deserve mention here, if the same causes did not forbid such a minute and careful examination as they require.

The object of this chapter has chiefly been to convey a general idea of the geognosy of the region examined this year. As this survey has been preceded by others, it cannot fail to contain some matter which will not be new to all readers, although it may be safely affirmed, that a greater length of time spent in the investigations, has added to the geognostic geography. To point out the ob-

servations which had already been made by others, would have led to a very useless verboseness. As the reports of my predecessors have been published, those who wish to discover the differences have the means at their disposal.*

* This remark has, I regret to say, been made necessary, because it has been thought that, in a newspaper article on the geognosy of Chesterfield, I had been guilty of the plagiarism of appropriating the discoveries of Mr. Tuomey. Fortunately no grounds were given for such a supposition; and I may venture to express the belief that neither the maps, nor the report now presented, bear the impress of an imitation of those of Mr. Tuomey.

CHAPTER III.

USEFUL MINERALS.

Division of subjects—Gold as hitherto mined in South Carolina—Want of Statistics—Mode of occurrence—Veins—Carolina Group—Wylie, Smith, Wilson, Mary, Sutton's Hagins, Potts and Brewer & Edgeworth Mines—Saccharoid Quartz Veins—Hornstone Lenticular veins—Huey and Wiatt's Mines in North Carolina—Stephens and Belk's, Belk's, Massey's, Funderburk's, Knight's, Phiffer's, little Blackman, Hale, Gay Ingram, Brewer and Leach Mines—Izell, Johnston Mines—Auriferous slate mines—Blackman Mine, Hendrix Mine—Gold Deposits—Coarse grain of deposit Gold—Decrease in depth of Vein Gold—Increase of available Gold in old tailings—Explanations of cause—Martin Mine—Brothers Belks' deposit—Westfield Creek Deposits—Copper—Its area in this State—Importance of our mines—Consumption and produce of the United States—Carolina Group—Features and Explanatory theory—Mines of this Class—Mary Mine—Ducktown Group—Nanny's Mountain Vein—Lead—Occurrences—Stroud's vein—Manganese—Bismuth of Brewer's Mine—Iron—Different Occurrences—Specular Schist—Itabirite—Hematite—Brown Coal of the Cheraws—Whortleberry Branch Deposite—Probable extensiveness—Value of Brown Coal in other countries—Character as a fuel—Applications—Clays, potter's, porcelain—Building Stones—Limestone.

In this chapter the useful minerals of York, Chester, Lancaster and Chesterfield, are described. They comprise the metals as well as the brown coal, clays and building materials. Many of these substances have been but recently found in our State, and, of the others, new occurrences are mentioned, so that the chapter can scarcely fail to contain matter of interest.

Our State is especially rich in metals, for with these nature has most liberally supplied her; so that all who feel interested in her welfare must anxiously desire the arrival of a time, when these resources shall no longer be permitted to lie dormant, and metals shall assume their proper position among the productions and exportations of the State. To expedite this it is necessary that those injurious speculations, which have so greatly retarded the prosperity of mining in North Carolina and elsewhere, should be avoided, and that in all

mining operations competent men should be at the head. We have numerous instances of failures owing to injudicious and ignorant management in our own State, and unfortunately such management has a tendency to stamp mining operations generally as uncertain and hazardous, while in reality they should be enumerated among the most valuable and important of all industrial modes of investment. As long as mining is regarded as a fit subject for speculation, failures must occur. In all other cases a good interest on the capital is thought a sufficient compensation; why then is it considered necessary that mines should double or treble the investment every year? It cannot surprise us that unreasonable demands should often be disappointed.

The subjects of this chapter are very distinct from one another. The metals are treated first. The following is the succession adopted:

Gold, Copper, Lead, Manganese, Bismuth, Iron; Brown Coal; Clays; Building Stones, Limestone.

GOLD.

Gold is one of the very few metals which have hitherto been mined in our State, although the manner in which the mining operations were conducted was of the rudest character, and calculated for anything rather than permanent advantage. It was entirely confined to what the Germans appropriately term "Raubbau," (robbery mining), and open cuts, that remind us of railroad excavations, and the present ruinous state of the mines attest the havoc which such injurious policy could not but produce. At present few gold mines in our State are in operation. The Martin, Hale and Brewer Mines, were the only ones I found not utterly abandoned in the four Districts surveyed this year, and at those, a few gleaners only were earning a scanty sustenance, chiefly by re-washing the old sands and gravels. No one at all acquainted with mining could have otherwise than anticipated this result, for it is impossible that a profession requiring as much study and experience as that of mining engineering, can be embraced and practiced on the same day. The instances, therefore, where mining, under these circumstances, has been lucrative, are ex-

ceedingly rare. There is moreover an unfortunate fascination about gold mining ("it is ready money every night," as an old gold-miner said to me once), that its attraction assumes a great similarity with gambling, when it is conducted as is usually the case with us. A fortune may therefore be made at it quickly, but is speedily lost again in seeking more. Nevertheless, gold mining, when properly conducted, may be exceedingly productive. We find instances at Gold Hill and the Huey Mine, at the latter of which the clear profit is from $18,000 to $20,000 a month.

It is exceedingly to be regretted that there is no possibility of obtaining any correct information of the productions of our gold mines since their commencement. The ownership has generally changed rapidly. The returns made to the proprietors by the little companies, to whom they have been in the habit of renting small lots, are generally very inaccurate; and even these, imperfect as they are, there seems a great dislike with most to make public. The cause of this may lie in a fear of taxation, if the value were to become known; but more probably it originates in a mere fancy for secrecy. From the United States Mint some report of the kind might be obtained; but, as much of the gold passed through different hands before coinage, its origin was often unknown to the one who delivered it over to the mint. In addition, a great deal was coined by Bechtler,* and it is now impossible to obtain the information he might be able to give.

Gold occurs in various ways in our State. In the Districts surveyed we may thus make the following distinctions:

1. *Silicious gold veins*, among which we must again make some divisions. We have first the quartzose veins, which terminate in copper and belong to the class which I have termed the Carolina group (see copper); secondly, those where the quartz is of a granular, saccharoid nature, rarely containing copper, and characterized by other

* Bechtler, a German by birth, for a long time, both anterior and subsequent to the establishment of the U. S. Branch Mints at Charlotte, N. C., and Dahlonega, Ga., coined gold from N. C., S. C. and Ga., much of which is still in circulation.

features to be discussed hereafter; thirdly, the hornstone lenticular veins.

2. *Auriferous beds of the slates.* These I have found in the talcose as well as the clay slates.

3. *Auriferous gravel deposits.*

Although the portion of the State as yet examined, is but small, it is probable that it contains instances of almost all the different modes of occurrence of this metal that will be found in the whole of our State; at least none others, of any importance, have yet been noticed in the auriferous States of the South. A trace only of gold I found in the porphyry of the Reid Mine, in North Carolina. In auriferous localities on the Pacific, and in other countries, the gold rarely occurs otherwise than in quartz veins or gravel deposits.

Among the silicious gold veins the first which demands our attention are *true quartz veins, whose gangue rock is of a lively crystalline character, usually of a slightly bluish cast. The veins abound in iron pyrites in the upper part, while copper pyrites appears in greater or less abundance at a lower level* (see copper). The veins at the Reid Mine in North Carolina, as far as the quartz is concerned, exhibit some similarity with the veins of this class, but iron pyrites is not abundant, and copper has only been found as a trace. The gold, which has now almost entirely disappeared at that mine, seems to have been confined to the upper portions of the veins, and was remarkably coarse or massive.* Veins resembling these I have not met with in our State, nor do I know of the existence of others like them in North Carolina. The veins, to which I at present desire to call attention in our State, are, with the exception of the saccharoid veins, the most common of all our gold veins, and exhibit features which are apparently uninfluenced by the character of the country rock, as will be seen by the different ones found at the various mines. In the Districts hitherto surveyed, I have met with

* It was at this mine that the piece weighing 28 lbs. was found. A story is fully credited in the neighborhood that another nugget, weighing 80 lbs., was discovered there also.

veins of this description in gneiss, mica slate, talcose slate and clay slate, while in North Carolina they are also found in dioritic slate. These peculiar veins are apparently most strongly developed in the two Carolinas, and hence, for the convenience of ready distinction, the term of "the Carolina group" has been proposed in contradistinction to the cupriferous veins of the valley between the Blue Ridge and Alleghanies, which might very properly be designated as the "Ducktown group." We shall have occasion to return to the subject when observing their importance as cupriferous veins.

The gold in these veins was originally present in the iron pyrites, though the lower level of the auriferous portion appears generally to descend below the upper level of the cupriferous part; to what depth, however, it is, in but few cases, as yet possible to determine. In the upper portions of the veins, that is to say in the gossan, we usually find the gold coarsest—a fact which can only be explained by that aggregation of the particles,* of the existence of which we have so many evidences in the veins and deposits of this metal, and even in old auriferous sands that have been once already washed or submitted to amalgamation, and have subsequently been left exposed to the influences of atmospheric action for years. I shall have occasion to return to this subject, when speaking of au iferous deposits, and shall therefore omit its discussion for the present.

In York, Lancaster and Chesterfield, we find several instances of veins belonging to this class. Those in York, are: Wylie's Mine, Smith's Mine, Wilson's Mine, Mary Mine, Sutton's Mine; besides some others of less importance. Those in Lancaster are: the Hagin Mine and the Potts' Mine. In Chesterfield we have only the Brewer & Edgeworth Mine, for Mr. River's veins have not yet acquired much importance.

The Wylie mine is situated near Mr. T. G. Wylie's store (Hickory Grove P. O.) in York District. The country rock is a talco-micaceous slate. The strike is N. 47° E. The vein is split up into several

* It might perhaps not be improper to call them atoms, although we imagine them with corporeal dimensions, which, in accordance with the atomic theory as it is at present received, we do not ascribe to atoms.

small ones, which in the aggregate are ten feet wide. The miners did not descend to a depth, where the vein consolidates properly, nor did they work through the whole mass, but confined their labors to the hanging wall and the first five feet of the width of the vein. The dip of the country, with which that of the vein corresponds, is S. 43° E. about 50°. The work which was performed here was exceedingly limited, extending only over a period of five or six months, during which short time even, it was irregular and carried on by three or four hands only. A rocker and a little drag mill were the only means of separating the gold. The latter is, however, said to have yielded ten to fifteen pennyweights a day. Some exceedingly fine specimens were obtained here. The quartz is more crystalline than in any other veins I have observed in this District, and well-developed crystals of quartz are very common. A melaphyre dyke appears in the immediate vicinity. The labor performed here was so very unsystematic and imperfect, that very little towards a full exploration of the mine has been effected.

The Smith's Mines are situated about one mile and a half west of the former. Unfortunately the works are in such a terrible state of dilapidation, having been abandoned for a number of years, that the observations which it was possible to make were necessarily exceedingly limited. Although at present in a state in which it was almost impossible to decipher the character of the work, it was yet easy to see that it had been very ignorantly conducted; shafts to strike the vein having, for instance, been sunk on the foot wall. The vein appears to have been very wide. The character of the quartz was of a kind to create confidence in the probability of finding copper, and I was afterwards successful in discovering some pieces of the gangue, in which occurred some particles of malachite, that may, however, have formed from copper pyrites after it was brought to the surface. The small quantity of this mineral found would indicate that the copper level had scarcely been grazed. A dyke of a syenitic rock occurs at the mine, and very probably had some connection with the metalliferous contents of the vein.

The Wilson Mine is situated about seven miles north-east of York-

ville. The country rock of this mine is micaceous slate. On the west, however, we find a continuation of the porphyritic dyke, which is seen on the southern extension of the vein at the Mary Mine. The strike is N. 35° E., showing a curve in the vein between the Wilson and Mary Mines, at the latter of which the strike is in a north-westerly direction. The vein may be traced with interruptions in a north-eastern course towards the Catawba for eight miles. It would be more proper, therefore, to say, that a long succession of veins occurs in this direction. The Wilson Mine is characterized by a very remarkable abundance of iron pyrites. As the ore worked was almost entirely confined to the gossan—in which the gold, originally present in the pyrites, had collected in particles whose size rendered them easier of extraction—a vast amount of valuable ore has been left on the surface, and awaits the more perfect treatment to which future enterprise may lead. The extraction of the gold from these auriferous pyrites should be preceded by a thorough process of roasting, as it was introduced near Rutherfordton in North Carolina, by Mr. C. Ringel, and afterwards practised with entire success on old tailings at the Gold Hill Mine and others in North Carolina. The sulphur is thus removed, and the gold exposed to the action of the mercury. As this process does not afford sufficient time for an aggregation of the particles of gold to take place, these are necessarily of a fine grain, and, consequently, the amalgamation should be conducted with care, and every endeavor used to avoid the washing away of the microscopic particles by too strong a current of water, and by seeking to be over expeditious in the extraction.

The works at the Wilson Mine were prosecuted to a depth of upwards of a hundred feet, the vein averaging seven feet in the deepest points attained, but varying from two to nine feet. It belongs to T. P. Black, Esq., and most of the work was done by him. They attained a depth of twenty feet below water-level, and it was chiefly owing to the water and the want of proper arrangements to keep it down, that the mine was abandoned. Unfortunately this mine is among those, where cessation of work for a number of years, the

caving in of some shafts and the filling up of others by water, caused the investigations to be chiefly confined to the attle heaps.*

This is probably the mine at which Mr. Tuomey discovered a trace of copper, although he merely designates the locality where he found it as being on the waters of Alison creek. I myself found a couple of minute particles of copper pyrites, and have no doubt whatever, that at a greater depth this vein will yield copper in a remunerative quantity. It is now offered for sale, and we may hope, as soon as mining enterprises are honored with a little more confidence in our State, to see this mine among the number which will be again put into operation.

At the *Mary Mine*, at present the property of the South Carolina Copper Company—a company organized and chartered for the proper exploration of its valuable contents—we find, on the southern extension of the Wilson Mine vein, that the copper level shows itself at the present surface of the ground. At the Wilson Mine they have scarcely touched the cupriferous level of the vein. For a full description of the Mary Mine, I must refer to the article on this mine in my second Report.

Sutton's Mine is situated in the North-eastern corner of York District, east of the Catawba river, and, on account of the country rock, the richness of the ore and various other points to be noticed in connection with it, presents peculiar features, which attach more than ordinary interest to it.

This mine, the property of Mr. Wm. M. Sutton, exhibits a vein in a gneissoid granitic country. The strike is N. 52° W., the dip N. 38° E. 45°. At one point the vein widens to such an extent that quite a considerable hill is formed by the bulky outcrop of quartz. Towards the east the vein separates, or, to speak more correctly, another vein enters the main vein. The quartz of the veins is finely crystalline; but, owing to the decomposition of a great

* *Attle Heap* (German *Halde*) are piles of dead rock and ore, not considered of sufficient value to work, which are thrown up near the pits. They very generally afford some of the best means of studying the character of the veins.

abundance of iron pyrites, exceedingly cellular. Jasper occurs in isolated bodies in the vein, but is probably confined to the gossan. The iron pyrites, which is unusually massive, in connection with the quality of the quartz, renders the discovery of copper beneath more than probable, although the value of its discovery is, as elsewhere, considered far less important than that of gold. The latter metal is very abundant here, and has been found in considerable quantity in the gossany outcrop of the vein, and on the surface of the foot-wall, although, as yet, nothing beyond mere surface panning has been engaged in.

The main vein, although in a granitic country, is accompanied by talcose slate on its wallings. This slate is of a chloritic nature, and is that which, in North Carolina, is termed the *slate of the vein.* It can only be regarded as a flockan, which has been subjected to metamorphosing action. Its width is variable and at no point considerable.

To those who may propose to work this mine at a future day, it may be of importance to know that a fine water power exists on the premises, which might be advantageously applied to run the stamps, etc., as it is but a short distance from the vein.

The *Hagin Mine* is situated close to Bell Air in Lancaster District. A section of the vein is given in Plate IV., fig. 7. In it A is the talcose slate country; B, the quartzose vein itself; C, auriferous gossan; D, the slate of the vein with gangue-breccia. The vein is four feet wide at the top. A few feet lower down it decreases to three feet. At the lowest point attained, it commences to widen again, the funnel-shape of the upper part being the result only of the latteral sliding of the vein walls, as this has already been explained in fig. 4, on Plate I. A great abundance of iron pyrites is seen in the upper part of the vein at E, E.

A number of years ago this mine was worked for gold, but it has long been abandoned. It is to be hoped that it will soon be resumed as a copper mine.

The quartz of the vein is porous, owing to decomposed iron pyrites

in the upper part of the vein. It is also less crystalline than the quartz of the Mary Mine, and rather more resembles the quartz of the Morgan Dover Mine in York, though its less saccharoid nature and an evidently increasing crystalline character, have induced me to describe it among the first class of gold quartz veins.

The quantity of iron pyrites and the quality of the quartz led me, on a visit in the early part of this year, to expect that copper would be found. The evening was, however, too far spent to admit of a careful examination. Later in the year another visit effected more definite results, and a number of specimens of copper pyrites were really found. This copper pyrites is disseminated through the quartz, and shows therefore some similarity with the copper at Morgan Dover's. It is probable, however, that this is a deficiency which will decrease in depth, and that it is, therefore, owing only to the fact, that the cupriferous part of the vein has not yet been sufficiently entered to arrive at more massive bodies of the ore. The same may, perhaps, also be the case with the Morgan Dover Mine, although the dissimilarity between the veins of these two places is sufficient for the present, at least, to separate them and place their descriptions under different heads.

The vein of the Hagin Mine strikes N. 28° W. The dip is very nearly vertical, but an inclination towards a dip in a northerly direction is perceptible at the lowest point exposed, so that it would be on that side that a shaft to strike the vein should be sunk. If not met with at the depth calculated, a level, driven towards the south, would meet it.

The mine is at present the property of Mrs. John T. Hagin.

The *Potts Mine* is situated in Lancaster District, one mile north of the Izell, and therefore close to the North Carolina line. The vein, indeed, extends into that State.

The strike of the vein is east and west. Its width is only two feet, but as very little work has been done, and no greater depth than about half-a-dozen feet attained, there is every reason to expect that it will widen a great deal within unimportant depths, especially

as the quartz is of that fine, bluish, crystalline character, which, with us, appears to be one of the very best evidences of persistency in depth.

The gossan of the vein has been worked by panning, almost exclusively, to a very slight extent, by a man of the name of Wm. Paxton. The depth attained was, however, sufficient to discover both galena and copper pyrites in addition to the gold. This vein is, therefore, one of those not over abundant veins of the Carolina group, which also contain lead (see copper). The quartz renders an increase in the useful metals, especially the copper, very certain.

This mine is on a piece of property belonging to the late Mr. William Potts.

The *Brewer and Edgeworth Gold and Copper Mine* is situated in Chesterfield District on the waters of Thompson's creek. On Plate IV, fig. 4, a section of the mine is given. A is the new red sandstone, through which one of the leaders (b) passes. B is the clay slate, the main country rock of the mine, which, as the figure shows, has a very variable dip at this point, a dip which is also quite unconformable with that of the new red. C is a little branch which separates the land of Mr. Joel Brewer, Sr., from that of R. L. Edgeworth, Sr., on both of whose properties some of the veins are situated. The intimate connection of the various veins on the two places, makes it necessary that they should be described together, notwithstanding the difference in the proprietorship. The main vein is seen at "a" on Mr. Brewer's property, while "b, c, d, e," and "f" are leaders and droppers, "e" and "f" being the only ones which are found to any extent on Mr. Edgeworth's place. These are ramifications or droppers of the main vein, and although they at one time afforded a sufficient quantity of gold to remunerate the labors of the miners, yielding about $10,000, they have been entirely worked out. Their finite character was already established by the peculiar nature of the little, or microscopic (to use an appellation of Fournet's) veins in the slate on the attle heaps, an instance of the importance of studying the veinlets in piles of refuse, a matter upon which Zimmermann, of Clausthal, laid so much stress. This proves also how

correct the advice of Fournet is, to devote the utmost attention to the study of the lesser (microscopic) veins, as they afford a perfect insight into the character of the larger ones, while their minuteness furnishes the means for a more comprehensive investigation.

The droppers "e" and "f" on Mr. Edgeworth's land, continue westward on Mr. Brewer's property, having been thrown off in a southerly direction by a large melaphyre dyke, which continues thence south-east along the edge of the granite until it strikes the tertiary formation, as is shown on the map. These veins have, therefore, shifted their position, to which is owing the fact of their appearance on the Edgeworth side of the stream.

The quartz of all these veins is very peculiar, and with regard to its stratiform character, resembles that of the Rēa and Pioneer Mines in North Carolina. It contains a great abundance of pyrites, both iron and copper, the latter increasing in quantity with the depth attained. The malachite, which is seen so frequently in the specimens lying about the old pits, has formed from the copper pyrites after it was brought to the surface. The copper pyrites is auriferous. The greater amount of this mineral on Mr. Brewer's side, where the deepest point reached is at a lower level than the bottom of the shafts on Edgeworth's side, furnishes an additional proof, if any were needed, that the increase of copper is in a downward direction with the veins of this class.

The size of the veins, as far as we know them at present, is comparatively slight, and does not exceed one foot. Should the working of the mine be resumed, it will require a skillful superintendance, as there will undoubtedly be many shifts and slides in the veins. From the section it will be apparent to every one, that Mr. Edgeworth's property presents no prospect of successful enterprise. Those veins, which he possesses, dip entirely towards Mr. Brewer's, and besides, they are droppers only, which have been, indeed, entirely worked out; so much so, that every particle of gold ore on the place was ground up before the mine was abandoned.

On Mr. Brewer's side of the stream—although irregularities will certainly be found in the veins, which will render their working more

difficult—there is every reason to expect a great improvement in depth, as they become farther removed from the melaphyre dyke (which appears here to have exerted very disturbing influences), while the droppers and leaders will increase the size of the main vein.

The main strike of the veins is N. 70° E., the dip N. 20° W. at different angles.

Most work was done on Edgeworth's side, only $2,000 worth of gold having been taken from Mr. Brewer's. The deepest shaft on Edgeworth's land is about seventy feet deep and extends to the lower termination of one of the droppers worked there.

The clayslate country rock is of a dark and silicious quality. The minor veins which occur in it afford some beautiful specimens, illustrative of shifts and other phenomena which have taken place in veins. Figure 5 on Plate I, exhibits a natural-sized sketch of a double shift of a little vein in a piece of slate from this locality. I have seen no other place which the student of vein geognosy might so judiciously select to acquaint himself with a variety of the important facts of which that science treats. The fissile character of the country rocks has doubtlessly had its share in rendering these so distinct, while the variety of the minerals—quartz, brown-spar, iron pyrites, copper pyrites and galena—tend to perfect those properties, for whose full development a greater diversity of minerals is necessary.

These are the principal mines, whose veins belong to the first division of the silicious gold veins, which are found in the Districts surveyed during the present year. Some veins at the Phiffer Mine, those of the old Gardner Mine, which now forms a part of the Ingram Mine, and, in Chesterfield, the veins of the McInnis and Kirkley Mines seem to belong to this division likewise. The latter is in a clayslate country, all the rest in the talcose slate. The veins from which the deposit worked at the Redding Mine were derived, judging from the character of the quartz, would appear to be referable to the same group. They have, however, never been opened.

There are many more, doubtlessly, which have not yet been discovered, while some have been found, but not been explored to an extent which would render their mention here of importance. Among

the latter we may particularize the veins on Mr. River's land, near Chesterfield C. H.

The second division of these silicious gold veins comprises those in which *the gangue rock is a saccharoid or sugar quartz.* As the name indicates, it is of a granular kind and resembles loaf-sugar. We find with us, therefore, a similar difference in the quartz with that to which McCulloch has called attention in Scotland. The quartz of these veins sometimes assumes a yellowish color, from the presence of hydrated peroxide of iron, but it is by no means uncommon to find large veins altogether of a pure white. Their size is ordinarily greater than that of the veins of the class just described, but they are far less regular in shape, and—this is a very important and characteristic feature—they uniformly decrease in size downwards, and disappear altogether the moment they strike the hard and undecomposed country rock below, without leaving any thread-like trace even, to serve as a leading string for farther explorations. Whether the veins ever again re-open in depth, in which case we might regard them as lenticular ones, has not yet been determined; for the mines have universally been abandoned when the veins first gave out upon coming in contact with the hard rock, accompanied as this usually is by the presence of water, which, strange as it may appear to experienced miners, offers an invincible obstacle to all mining operations with us. These veins are singularly influenced by every change in the ground, a slight increase in hardness always causing them to be "pinched up" as the technical term is. I know of no instance of a total absence of gold in these veins, in the region hitherto surveyed, though the quantity may sometimes be too slight to permit them to be worked with profit. This metal, as found in them, is of a very fine grain, and almost always of a scaly character. It is generally imperceptible to the eye, although the ore be rich. Copper, I have but upon two occasions found in veins of this class. This was in the Morgan Dover veins and one of the eighteen-feet veins at the Mary Mine.

These veins are probably the most common among all the gold veins of the Atlantic States. They are found as far south-west as the

terminus of the crystalline slates of the Alleghanies in Alabama. In the part of this State hitherto surveyed, they are less abundant than they will become in the westward progress of the survey, as they are almost entirely confined to the region west of the south-western and north-eastern prolongation of King's Mountain. Thus of the four Districts of which this report treats, York is the only one in which they are found, and even in that District they have to a very slight extent only become subjects of mining operations.

Of the veins belonging to this class it will be possible to particularize only those of the southern termination of King's Mountain, which were, years ago, slightly explored by Mr. Black; those at the Martin Mine, from whose detritus the auriferous gravel deposit, worked there, was formed (see Martin Mine); those of Mr. Morgan Dovers, which are cupriferous, and will therefore be spoken of more at length under the head of copper; and those large (18 feet) veins, which occur at the Mary Mine, and will consequently be mentioned in the description of that mine.

We now arrive at the third division of the auriferous true veins, a division which, owing to its extensive distribution in a part of the territory explored this year, as well as on account of its productiveness in gold, occupies a deservedly high rank among the gold veins of the South. I allude to the *lenticular veins, whose chief gangue rock is a hornstone.* These are to be found in Lancaster and Chesterfield, and belong essentially to that talcose slate belt which lies to the east of the granite of the Waxhaws, and is severed by the younger granitic and syenitic dyke of Taxahaw and Chesterfield. On the north side of this dyke—to which many, if not all of them are probably indebted for their metalliferous contents—this division comprises the succession of mines of Messrs. Stevens, Belk and Dr. Massey (deceased), the unexplored mine from which the deposite, which proved so productive to the Brothers Belk, was derived; the Funderburk Mine, Knight's Mine (in part), Phiffer's Mine (in part), and the most southern of the Blackman Mines. All of these are in Lancaster, as are, likewise, to the south of the dyke, the Hail and

the Gay Mines and the Ingram Mine (in part). In Chesterfield we have the Brewer Gold Mine and the Leach Mine.

These veins all present some general features which, though differing but slightly at the various localities, afford modifications quite sufficient to render it possible in most cases to refer the ores to their proper sources as well as to point out diversities in the special conformation of the veins themselves. These local variations render it difficult to give a complete general definition of the main characteristics, owing to the simple fact that these differences are more irregular in this group of veins than in most others, and that they are modulations of various features. It has been already said that the veins occur in disconnected, lenticular bodies, a fact which of itself already implies variety in form and dimensions. When they show themselves with greater regularity, they appear intimately connected with the rhomboidal jointure planes of the talcose slates in which they occur; so much so, indeed, that it is at first difficult to imagine them true veins and really distinct from the beds of the slate, especially as the mineral composition of the gangue differs from that of the country only in a greater amount of silica. In color, both agree, the vein rock only exhibiting somewhat less opacity than the barren slate.

At the Huey Gold Mine, in North Carolina, though close to the Lancaster line, we find an admirable illustration of this class of veins, and as a greater depth has there been attained than at any similar mines in our State, it will be advisable to introduce a short description of it here, for this will explain the character at greater depth of the same mines with us. At this mine it is extremely difficult to distinguish between the barren slate and the ore. The former is indeed, probably, though a gangue rock, synonymous with the *hyalistire* of Riviere. The ore is characterized by a greater amount of silex, and by its less greasy but more adamantine lustre. It may be properly termed a talcose hornstone. Sometimes it passes into a banded agate, though the color is but little varied, extending only from black to a greyish white. Gold rarely occurs in visible par-

ticles, though some specimens have been procured almost coated by the precious metal. The gold is worth but 87½ cents a pennyweight, and the mine is therefore, in regard to the purity of the gold, far surpassed by some similar mines in our State. Thus, for instance, the gold of the Brewer Mine is worth about 102 cents a pennyweight. That we have veins and not beds to deal with at this mine, is evinced by the fact, that there is a main vertical body or the auriferous hornstone, towards which the latteral bodies dip. An ideal section, representing the position of the main vein and lenticular leaders, is given in Pl. III, fig. 8, where "*a b*" represents the former and "*c, d, e, f, g, h*" the latter. The terrace-like convergency of the leaders towards the main vein is there exhibited in the manner in which the mining explorations have proved it to be the case; for although, at a depth of one hundred and fifty feet, the leaders have not yet joined the main vein, still we must infer that they will soon do so, as they are constantly approaching it. The main vein seems itself to be somewhat lenticular in its shape, as from the surface downwards it first widened to five or six feet, and has now decreased to two. The strike of the veins is N. 65° W., while the dip averages 80°, converging towards the main vein. These veins must remain unexplained, until more protracted mining operations (if continued as they are at present progressing under the proprietorship of Commodore Stockton) shall have completely laid bare their features at greater depths. It is a matter of importance to miners as well as of interest to students of vein geognosy, that the white quartz veins which abound at the Huey and the adjoining Wiatt Mine, and traverse the hornstone veins, never contain a particle of gold, and that, according to Mr. Friedeman's observations, they render the latter equally barren at the point of contact. The same absence of gold exists in the white quartz veins of the Brewer Mine in Chesterfield. At Gold Hill, in North Carolina, gold is obtained from the white quartz veins, though the mine is essentially of the same class as the Huey. This and the Ingram Mine are, however, as far as I am aware, the only exceptions.

There are two small dioritic dykes which bisect, but do not inter-

rupt, the auriferous veins, though these are cut off to the north-east by a melaphyre dyke.

In our State I have seen no mine of this class in which a sufficient depth has been attained to expose the undecomposed slate, and the analogies, therefore, with the mine just described must be sought in the upper or older works of the latter, and there we find them very apparent. The auriferous portions are confined, in the upper levels, to silicious and generally also ferriferous parts, which are, however, in such a state of disintegration—owing probably to the former presence of iron pyrites and other oxidizable minerals—that it requires considerable experience before they can be separated from the barren and decomposed slates. This is rendered more difficult because at the commencement, near the surface, these auriferous portions or *pockets*, as the miners term them, are usually of very small dimensions. At the Wiatt Mine, which, as far down as the works extend, very nearly corresponds with the Huey Mine, Mr. Friedeman, its former superintendent, observed that the auriferous portions were characterized by the dissemination—through the decomposed talco-silicious mass—of a great quantity of minute black specks, which are perhaps crystals of magnetite. These were often the only distinguishing feature between the auriferous and the barren rock, as the former is more than ordinarily talcose, and the latter highly silicious. Both present but little difference in their general coloring and are equally friable.

Stevens and Belk's Mine is the property of Messrs. Wm. Stevens and T. M. Belk, and is situated seven miles from Lancaster Court House, in a north-eastern direction. It was worked with success for a short time, but, owing to deficiency in a proper knowledge of mining, the work was soon abandoned.

There are several veins which strike N. 67½° E. The gold contained 85 to 90 per cent. of the pure metal, and even the refuse ore at the mouth of the pits pans remarkably well.

Thos. M. Belk's Mine.—The strike of the vein is N. 62½° E.

It was worked pretty successfully by Henry Belk, and like the former, probably only needs a thorough and discreet management to prove productive.

On the north side a melaphyre dyke cuts off the vein, and may be expected to enrich it.

Massey's Mine is the property of the late Dr. B. C. Massey, adjoining the former. Strike of the vein N. 62½° E., dip 90° N. 27½° W. It was formerly worked by some Englishman, who sunk a shaft on the vein.

As all three of these mines have been abandoned, the presence of water in the shafts and the great dilapidation of the works, which were originally mostly of a very rude character, prevented an examination of the veins in the shafts and pits; the result of numerous pannings, however, and their geognostic correspondence with those mines more completely opened in North Carolina—and universally admitted to be the most productive and persistent of all their gold mines—ought certainly to cause their resumption.

For a description of the gold veins near the rich deposit worked by the brothers Belk (see gold deposits).

The *Funderburk Mine*, is situated on Lynch's creek in Lancaster, between a dyke of the coarse trachytic rock of eastern Lancaster, and a peninsular-like portion of the great granitic dyke, which has separated from the main body as shown in the map. The granite is seen immediately south of the mine. In composition it is entirely distinct from the syenitic rock of Taxahaw, and from the highly felspathic rock of Hanging Rock, being a true granite of a very fine grain and grey color, resembling therefore the enclosed masses of a fine grain in the porphyroid syenite of Taxahaw (see granites).

The strike of the veins, or succession of veins at the Funderburk Mine is N. 65° E., the dip is on the whole, as far as explored, vertical, though the lenticular veins themselves are individually very variable in dip. A very instructive section of this mine, or rather of a wall of one of the shafts, is represented in Pl. III, fig. 3, where the shaded masses are the lenticular veins. These are, however, not always auriferous at this mine, and the presence of the metal seems confined to the selvages, which is not usually the case in mines of this class. It is not improbable that here the present position of the gold was assumed at a far later period than the forma-

tion of the veins, and the time of its original introduction. The gold is generally found in the more cleavable portions of the slate, close to the veins; but, from the fact that it is never present in the slate at any distance from the veins, and that the auriferous slate, from its quartzose character, indicates an introduction into it of a portion of the vein material, it becomes very evident that the origin of the gold is ascribable to the veins and not to beds of the slate. Whether these more schistose and auriferous contact portions of the slates were originally flockans, to which afterwards their peculiar structure was imparted, or whether they are really a part and parcel of the slate, which subsequently received the gold from the veins, is a matter which it is at present scarcely possible to determine. At all events, we must expect that at greater depth the gold will be found in the veins themselves and not along their margin.

This mine has been abandoned for two years, although a good deal of the ore yielded a pennyweight per bushel. Prior to the revolution a pit was sunk here by a man by the name of Fudge, whose old works are found scattered over Lancaster and Chesterfield, and who, to judge by a shaft of his at the Brewer Mine, was a miner by profession, and had previously probably been engaged in copper mines. What he sought, or found here, it is difficult now to establish.

Whether this mine will ever be resumed or not is uncertain. At all events, there is but little doubt that its importance, when compared with other mines, is of greater scientific interest than practical value. It is one of the most instructive localities I have seen, in affording explanations and full illustrations of the peculiar and remarkable class of veins, of which it is an instance.

Knight's Mine, *Phiffer's Mine*, and the most southern of the *Blackman's Mines*, possess veins belonging to this class; but, as they have been but very slightly worked, their internal features have not been sufficiently explored to afford matter of import.

The *Hale Mine* is one which merits more than ordinary attention, as well on account of its former productiveness, as the fact that, the works having been extensive, it is possible to enter more thoroughly into an investigation of its special characteristics.

On plate III, figures 6 and 7 present different views of portions of this mine. In fig. 6 we have a vertical section, where "*a, a, a*" are lenticular auriferous bodies, which, as the sketch shows, are exceedingly irregular. This section is taken from the wall of one of the open cuts. The strike of the slate at this point is N. 75½° E., the dip 53½° N. 14½° W. Fig. 7 represents a ground plan view of the lenticular veins at another part of the mine. Both figures indicate a certain degree of conformity in the strike and dip of the lenticular bodies, with that of the slate (the strike of the former is N. 45° E., that of the latter N. 65° E. in fig. 7); but "*b, c*" and "*d*" in fig. 7 show, by their south-eastern prolongations "*f, g, h*," that a latteral pressure in this direction was exerted. Of this fact the isolated mass "*c*" affords another proof. The pressure seems to have been directed towards a more southern quarter than that influencing the strike of the slate. The difference is 42° farther south, the strike of the slates being N. 65° E., and that of these prolongations of the lenticular veins S. 83° E. The figure shows the slates to be curved in correspondence with the boundaries of the veins, which can only be explained by the schistose structure having been produced subsequently to the introduction of the vein mass. The southerly prolongation of the veins should receive the utmost attention in future mining operations, as it will be of importance in following up the veins and in adapting the works to future proceedings.

A melaphyre dyke "*h i*" striking N. 35° W., crosses the lenticular vein "*a a*," having a slide in the middle, and causing also a shift in the vein.

The ores of this mine differ more from one another than those of the Brewer Mine. This is owing to an occasional far greater abundance of iron pyrites, which occurs in pocket segregations in the veins, and has led to the belief that it indicated the presence of separate pyritiferous veins. Nothing of the kind is, however, the case. This pyrites, notwithstanding its auriferous character, has been thrown aside, as the processes of roasting were not understood. In these heaps a great quantity of sulphate of iron has formed. We

also find sulphur in botroidal masses, which, owing probably to the heat engendered by the oxidation of the iron and part of the sulphur, exudes in some places, and may be collected in quite a considerable quantity. This formation, or separation of native sulphur serves, likewise, as an explanation of the very common occurrence of this substance in the upper, oxidized parts of veins.

In some places, owing to the decomposition of the iron pyrites, the ore is not to be distinguished from the porous and highly friable ore of Stephens' and Belk's Mine. Regular hornstone is rarely met with, although in depth we may expect to find ores more resembling those of the Brewer.

The deepest work extended to a depth of ninety-three feet. The veins "*b*" and "*c*" were worked to the lowest levels. The operations were all exceedingly rude. Indeed, the injurious system of renting to small irresponsible companies could induce no well regulated management. Nevertheless the mine continued for a long period of years exceedingly profitable—the causes for its final abandonment being those only which could not fail to result from the unscientific and ill-judged conduction of the operations. I found a few hands engaged in re-washing the old tailings; but this can scarcely be regarded as re-instating it in the list of operating mines. Still no doubt can exist that at some future day it will be re-opened.

This mine has yielded some nuggets, worth from $300 to $500 each. The metal was found in greatest abundance on the jointure planes, which seem to have offered greater inducement for aggregation. The melaphyre dyke was also observed to have exerted a beneficial influence.

Some branch deposits occurred at the mine, which, as long as they lasted, yielded richly.

The Hale Mine has evidently been entirely misunderstood by most who have formerly examined it, a fact which may be ascribed to a want of the means of comparing it with analogous and more fully opened mines.

The *Gay Mine*, now belonging to Mr. N. Gay, but formerly known as the little Brewer Mine, is a south-western prolongation of the Hale

Mine veins. It is situated at the very edge of the talcose slate, where this touches the clayslate. The main strike of the lenticular veins is N. 52½° E., the dip vertical. The country rock has occasionally a slight dip towards the north-west, though generally it is vertical. Towards the east the passage into clayslate is gradual. The latter rock underlies the deposits, derived from Gay's veins, which have formerly been worked on Mr. Todd's land. The strike of this clayslate is here N. 44° E., the dip 45° S. 46° E. Todd's Mine was formerly called the Lanier. Nuggets of some size were found here, but the deposit is now pretty well worked out. Good management might still, perhaps, render the veins of the Gay Mine profitable, although they are very contracted in comparison with those of the Hale.

The *Ingram Mine.*—The work which has been done here is confined to a white quartzose vein and the deposits formed from it, and, in this part, was formerly known as the Gardner Mine.

This mine is interesting as affording one of those very rare instances of auriferous white quartz veins, accompanying auriferous hornstone lenticular veins. The latter veins are a direct continuation of those at the Brewer Mine, which are covered by the clayslate (therefore older than it) on the road from Taxahaw to that mine. They present at both localities the same features (see Brewer Mine) and contain alike iron pyrites and the new mineral found at the Brewer Mine, (q. v.) These lenticular veins have as yet not been explored, though they certainly merit the utmost attention.

South of the succession of lenticular veins lies the white quartz vein formerly worked. They are about fifty feet apart. The latter strikes north-east. It does not exceed six to eight inches in width. Its small size, therefore, precludes the possibility of deep mining. This is not the case with the unopened lenticular veins, with regard to which the fact of their never having been injured by ruinous mining operations, will add much to their value when they are worked at some future day.

The *Brewer Mine* is situated on Lynch's Creek in Chesterfield District. As there are various points of interest connected with it,

which have long called attention to its geognostic conformation, we cannot avoid experiencing some surprise that this should have been so completely misinterpreted by former observers, although there are a variety of reasons why this mine should have been so difficult to decipher, and why its somewhat complex character should have led to misconceptions. Like the Hale Mine it has never been viewed in connection with mines of a similar character; partly probably from the fact that the unusual and certainly very great size of the lenticular veins rendered a comparison somewhat difficult; partly because the highly disintegrated state of both gangue and country placed obstacles in the way of their separation and exact distinction; but principally, in all probability, because a most savage and wasteful treatment of the mine, the natural consequence of the injurious policy pursued with regard to it, has introduced such utter confusion, that an attentive and protracted investigation can alone establish its true character. It is not impossible, also, that its separation from most other mines of the same class, by the syenitic dyke, may have induced misconstructions.

Figure 1 on Plate III, furnishes a section of this mine. At "a" we find a portion of the granitic dyke, which has here exchanged the hornblende of the syenite of Taxahaw for mica, although it has retained the coarse porphyroid character of the felspar. South of this at "b" we find a contact dyke of the coarse trachytic rock of eastern Lancaster. This abuts against the talcose slates "c, c," which contain the lenticular veins, "f, f," and "g," as well as the white quartz veins "i, i;" "d," is the clayslate seen at the Slate ford, while "h," is the auriferous deposit known as the Old Tan Yard.

The section shows three main belts or connected groups of lenticular veins. Of these the two northern ones have only been worked. The other "g, g," crops out south of the Old Tan Yard deposit, and still remains in its original state.

The strike of all the lenticular veins, as well as their dip, corresponds with that of the slates, the former being N. 70°–72° E., the latter 60°–63½° N. 18°–20° W. Their width is from twenty to thirty feet, and sometimes even extends to fifty.

The hornstone of these veins in its original state is blue, though varying, in depth of coloring, from indigo to sky-blue. It is, however, even on the Blue Flint Hill, not often met with in its undecomposed state, and when it does occur, is generally found only in the central parts of the lenticular veins, where it exists in the shape of kidney-like masses. The disintegration of the hornstone is assisted, if indeed it be not caused, by the presence in it of iron pyrites, not unfrequently with the accompaniment of copper, and a new mineral,* which, though never found in large crystals, occurs in considerable abundance. All these are disseminated through the gangue, and in the first stage of disintegration, produce partial porosity and a discoloring of the rock, which then assumes a reddish cast, more or less intense according to the quantity of oxide of iron present. In the centre of these pinkish masses, we find a kernel of the blue hornstone, sometimes many tons in weight. A farther disintegration results in the production of a sand of a fineness of grain so nearly impalpable, that it reminds us of the remains of silicious infusoriæ, which are employed for polishing plate, and which constitute, for instance, the infusorial slate of Bilin, in Bohemia. At this stage of disintegration it is impossible to lay down the boundary line between it and the decomposed, highly silicious, talcose slate country rock, as both are then equal in color (white), and texture, and the talcose ingredient of the slate is rarely in a shape admitting of occular detection.

The whole mass of the hornstone gangue is auriferous, although the gold is often inattainable by the simple and inefficient means of extraction employed, as well on account of the hardness of the ore, and fineness of the gold in grain, as of the intimate association of the latter with the iron pyrites.

The gangue rock of the veins is traversed by the same jointure planes, which show themselves in the slates. These are usually richer in gold than other portions, and it can, therefore, not surprise us that the miners, ignorant of the true nature of the mine, should

* This mineral proves to be enargite—see Second Report.

term them veins. I have found them of very different strike and dip. Thus at Baker's whim shaft, on the most southern of the two summits of the Blue Flint Hill, some dip 60° N., others 26° S., and again others N. E. At other parts of the mine there are such seams striking N. 35° W., dipping vertically or N. E. 60°–75° and S. W. 75° to 90°, N. 75° E., S. 15° E. 45°. Among the latter, the second one alone contained no gold. Many of the fissures have very evidently been filled from above, so that, in these cases, the presence of the gold is ascribable to surface washings. This may be observed with great distinctness just above the extensive deposit known as the Old Tan Yard, where a seam of a vertical dip is auriferous, and another dipping more horizontally is perfectly barren. A matter connected with this washing in from above is the fact, that very frequently soft disintegrated masses, of a highly auriferous character, are found beneath undecomposed parts of the vein, having found their way in from above. The washing which occasioned it at the same time effected a concentration of the ore, so that it now proves richer than the rest.

Numerous barren white quartzose veins, of every possible strike and dip, traverse the hornstone veins and the slates without any regularity, but with great frequency of occurrence. The hornstone veins are sometimes cut off by them, although their size rarely exceeds one foot. These render the mine what German miners term a "Truemmerstock." In figure 2, on plate III, some of these veins are represented at "a, a;" "c, c, c," are fissures filled from above, and containing gold. The same we find to be the case at "d," a connection having, in all probability, once existed at "f," where the seam is now closed. Jointure planes are seen at "e." The sketch is on the same scale as that of the Funderburk Mine.

The Tan Yard ("h" in Pl. III, fig. 1), where the first gold won at this mine was made, is exclusively a deposit, resulting from the disintegration and washing away of the upper parts of the veins to the north of it. It thus affords an instance of the fact, already once alluded to, that deposits arising from the attrition of veins should be sought on their foot wall side. At "g," to the south

of the Tan Yard, another series of lenticular veins occurs, which cannot, however, have assisted in the formation of this deposit, though it may have furnished a part of the gold which was found in the southern continuation of the deposit. The hornstone of these veins, being in a less advanced stage of disintegration, is harder than that of the rest, to which it is probably ascribable, that they have never been worked. A compact breccia, cemented by iron, underlies the Tan Yard deposit.

Although this mine has been in operation for a far longer period than any other in the State, and every branch, bed, gulch, ravine, or even declivity of the main hill, has been washed and re-washed, and although the whole surface is torn up in the most extraordinary manner, and a depth of from sixty to seventy feet attained, yet they have never struck the undecomposed talcose slate, while the veins themselves, with the exception of unimportant central portions, were entirely disintegrated.

Mr. Tuomey, in his report, already speaks of the ruinous effect which the system of letting to small, irresponsible companies had even then exerted upon this mine. Successive years have increased the injurious results. The mine itself has probably few equals, and, on account of the quantity and purity of its gold, the minerals accompanying it, (see Bismuth,) the great number of miners once employed here, (several hundreds at one time,) occupies a position of singular interest among the mines of South Carolina. The plan pursued by the proprietors was, however, the best which could have been selected to ruin it. They were in the habit of letting out small lots, the stakes of whose boundaries are still left in some places as memorials of the imprudent policy pursued, if indeed the present state of the mine did not sufficiently illustrate and prove its evils. This process, commencing at the Old Tan Yard deposit, was continued on the Blue Flint Hill, and the pits were sunk by the side of one another, without any regard to security or stability, each lot being worked independently and without any reference to neighboring ones. Hardly any regular shafts were sunk, and huge excavations meet the eye scattered about in the utmost confusion.

The amount of labor here so wastefully expended, if guided by proper knowledge and constrained within the bounds of moderation, would doubtless, by this concert of action, have produced results whose beneficial effects would long have been felt. As it is—although at one time the productiveness of the mine was so great, that the laborers slept by their pits with loaded rifles—now a few scattering individuals can scarcely gain a scanty livelihood. This is in part caused by the extravagant rent which the miners are, by contract, obliged to pay. The gold contains 986 parts in a thousand of pure gold, and is therefore worth about $1.02 per pennyweight. Yet the miners, who are required to sell it to the agent, receive but 72 cents a pennyweight for it, as I am informed, paying, therefore, nearly 30 per cent. as rent. This of course excludes all but the most needy. As a natural consequence, those only are to be found there, who have not the means to avail themselves of the advantages afforded by machinery. This, indeed, has been formerly even but sparingly employed here. Chilian mills and arastres were used, it is true, but "long Toms" and rockers were chiefly employed. The latter only are now in use at the mine. Steam-power was never applied; yet it is this alone which, by enabling the ores to be taken, rank and file, as they come, can ever redeem the mine. It is to be hoped that a day may arrive when it will be taken in hand by competent men, supplied with ample means, and then there is little room to fear that it will be found wanting in productiveness.

A statistical view of the amounts of gold taken from this mine since it was first opened, would have been exceedingly interesting, but I regret to say, that the chief proprietor, Mr. Brewer, guided by motives of which I am not cognizant, was unwilling that this should be made public.

The *Leach Mine* is also in Chesterfield District. Its importance is, however, but slight, although its geognostic character obliges us to class it with the Brewer Mine. It has been worked to a slight extent only.

There are still some gold vein mines remaining, which, though differing considerably in themselves, cannot be properly classed with

any of the foregoing ones. The mine, which occupies the most important position among these, is undoubtedly the *Izell Mine.*

This is situated in the north-western part of Lancaster District, immediately adjoining the North Carolina line, where the granite of the Waxhaws enters that State. A section taken from a wall of one of the excavations is given in Pl. IV., fig. 3, where "A, A," represents the talcose slate and "B, B, B," disconnected portions of the veins. To the student of vein geognosy the section must be of interest, as it affords a peculiarly beautiful illustration of the manner in which veins bifurcate near the surface. In addition to this, it exhibits very plainly, at "C, C, C," the increased lamination of the slate near the veins; a fact which may also be observed in the section of the Funderburk Mine. In this both greatly resemble some of the sections given by Fournet.* It is not impossible that explorations, continued to a greater depth, may discover this mine to belong to the lenticular vein mines, though the white quartz of these veins would indicate a different character. The mine was at one time pretty extensively worked, although the operations were confined to portions but little removed from the surface. It was found that a melaphyre dyke, which occurs here, three feet in width, striking N. 28° W., and, therefore, cutting the veins, materially increased their productiveness. The main strike of the veins is N. 70° E., although I found some striking N. 37½° W.

The *Johnston Mine,* also in Lancaster, situated pretty centrally in that District, differs entirely from the Izell. A section of it is given in Pl. II., fig. 3.

In this section, "a a" represents a quartzose vein; "b, b," its immediate walling or flockan; "c," an auriferous seam; "d," the talcose country; "e," the whim-shaft.

The gold-bearing seam is somewhat funnel-shaped, and very nearly gives out at the lowest point of observation. The matrix of the precious metal is of a talcose slate character, and may possibly originally have been a flockan, the gold in which was derived from higher

* Simplification de l'Etude d'une certaine Classe des Filons.

portions of the quartz vein. At a point lying higher than the mouth of the shaft, gold even now occurs in the vein, although none is found in it at the pit.

The quartz of the vein would induce us to place it in the first class of gold veins, were it not that the presence in it of pyrolusite, an ore of manganese (visible at a part exposed by an old pit, sunk three-quarters of a century since by Fudge) distinguishes it from any of that class hitherto observed. It may be, however, that, in this instance, this mineral occupies the position otherwise taken by lead ores, for the character of the quartz affords inducement to expect the presence of copper at depths hitherto not attained.

The size of the quartz vein is two feet, its strike E. and W. at the shaft, at the Fudge pit N. 75° W. The dip is 45° S., while the slate dips to the north. The gold vein is one foot from the quartz vein, and about one foot in diameter. It is a noticeable fact, that wherever the quartz vein approached the gold seam, or where quartzose leaders traversed it, the gold was found to have disappeared.

The depth of the shaft is seventy feet. Water, foul air, and the contraction of the gold seam, were the causes of the abandonment of the mine two years since.

Thus far auriferous *veins* alone have received our attention. The metal, as previously remarked, however, occurs also in other ways. Among these the *auriferous slate beds* are the first to be discussed. The only kind of slate in which I have hitherto found gold-bearing strata in our State, are the talcose and clayslates. In Alabama I observed a silicious hornblendic slate, which also contained this metal and had been worked to a considerable extent. Two mines only of this description can be mentioned here, the Blackman Mine in Lancaster, and the Hendrix Mine, in Chesterfield.

The *Blackman Mine* is situated about a mile and a half north of another mine of the same name, mentioned under the head of the hornstone veins.

Two sections of this mine are given on Plate III. Figure 4 is a natural one, a sketch of a wall of one of the deepest excavations. The height of the wall is about fifty feet. Figure 5 is an ideal

section, illustrating the curvature of the strata. In both, "a a" represents the auriferous part. In fig. 4 is seen the mouth of a level, which leads to the lower works, where the deepest part, at the curvature of the beds, were operated upon.

The slate is an almost pure talc, of a color which passes from silvery whiteness to a rich fawn and a bright green. The presence of minute silicious accumulations, about three-tenths of an inch in diameter, has locally given it a wavey appearance. These diminutive quartzose nodules occur in the seams, which were found to abound most in gold, although they are not absolutely indicative of the metal, for I observed some of the same kind of slate which contained not a particle. The auriferous strata are generally the most brilliantly green of all, though sometimes a greyish stratum is found to contain gold likewise. A rule with regard to either of these distinctions, it is, therefore, impossible to make. It was only by following certain beds, that the miners were able to separate the ore from the attle. That the portion marked "b," in the two sections, was found less remunerative, is simply ascribable to the fact, that less compression of the strata, than at "a," resulted in a less perfect concentration of the ore. In other words the part "a, a," was rendered denser than the part "b," and, consequently, the proportion of the volume of the gold to the volume of the slate is greater in the former part than in the latter. Could it have been possible to have ascertained the average specific gravity of the two parts of the same beds, before lateral pressure ensued, that of both would probably have been found the same; while, with equal probability, a difference would have been discernable after the pressure took effect, but before disintegration and decomposition had converted the beds into their present shape.

A deposit, where very coarse gold occurs, has formed from the abraded portions of the slate, and has been worked to a considerable extent. Money might yet be made there, some of the ore yielding, as estimated from panning, $2 per bushel. A few large nuggets were found at this place.

This mine has been pretty thoroughly exhausted. The operations

extended to a depth of from ninety to ninety-four feet. Mr. Henry Gardner was the one who worked it chiefly, indeed, till within five years. The deposit was worked by others long before.

The gold in the slate is very fine in grain, and is worth over a dollar per pennyweight.

The strike of the slate is N. 77½° to 80° E., the dip 58° N. 10° to 12½° W., although, as the sections show, the latter is variable.

The *Hendrix Mine*—A section of this mine is given in Pl. II., fig. 5. The auriferous bed is represented at "d," while "b, c, e, f, g," contain no gold, although presenting no apparent difference from "d." All are beds of clayslate, of a brownish color, ascribable to peroxide of iron formed on the decomposition of iron pyrites, the altered cubes of which are abundant; "a," is a gravel bed underlying the soil. The auriferous stratum is four feet in diameter, the two central feet being the richest. The strike of the slate is N., the dip first 11° E., and afterwards almost vertical. No gold exists in the gravel.

The place is situated about two miles south of Mt. Croghan. As yet it has been but very sparingly worked, (by a Mr. Talmadge,) but it is hoped that further explorations will be made, as this mine is certainly the only known instance of the kind in the United States, perhaps in the world.

Gold Deposits—This is the third and last division of the natural occurrences of gold in the part of the State surveyed this year. They are secondary accumulations of gold, in depressions, or along water courses, the gold being derived from veins or beds.

The Atlantic and Gulf States possess no deposits of an extent which can entitle them to the importance attaching to those in California, Australia, Africa and Siberia, but yet there are some in our State which cannot be omitted in this report.

Before proceeding to the special description of the deposits in the Districts surveyed, it will be necessary to explain an important matter connected with them. This seems to me more especially necessary, because I never yet noticed any remarks on the subject in works even which one might reasonably expect to touch upon this topic.

Every gold-miner must have observed that the metal in the deposits is of far coarser grain than in the veins whence they were derived. There is probably not a single exception to this rule, and it is perhaps an ignorance of this fact which has induced many to believe that they had not discovered the original source of the gold, because the particles in the vein itself were so diminutive when compared with those in the deposits. Had mere mechanical forces been in operation only, the attrition consequent upon the washing and rolling must have lessened the size of the particles in the deposit. We must, therefore, look for other agencies to account for the phenomenon, for it is very apparent that an increase, instead of a diminution in size, has taken place.

Before offering an explanation, it is necessary to look further than to deposits only, and to collect all the facts relating to the subject.

It has been observed in North Carolina and California, not only that the upper portions of veins are the most productive, and contain the gold in the largest granules, but that roots of trees growing on the tops of vein-outcrops (especially those, it is affirmed, which have been struck by lightning) are sometimes partially almost coated by the precious metal. We see also that every laborer at gold mines is induced to put the question, "Does gold grow?" when he finds old tailings, that have been allowed to accumulate for years at the gold mills, still, when re-washed at successive intervals, returning almost as much gold, and sometimes more, than when operated upon the first time.*

Gold really does grow and is continually growing, though certainly not in the way in which the querists understand it. That is to say,

* In an article by Freisleben on the occurrence of native silver in Saxony ("Jahrbuch, von Leonhard and Bronn, 1845," and "Berg und Huettenmaennische Zeitung," 22d October, 1845,) he alludes to the supposed formation of native silver in old attle piles, and in the ancient hitch, made for the support of timbers, at the Drei Weiber mine. Both of these cases would seem to gain support by what has been said regarding gold, and Freisleben's unwillingness to subscribe altogether to this opinion would scarcely have existed, if he had been acquainted with the formation, or more correctly speaking, aggregation of gold in the piles of old tailings.

an individual particle may grow, may increase in size, but the smaller ones are absorbed into the larger, and no actual increase in the quantity present has been effected. An increase has really taken place in available, attainable gold, without any increase in the actual sum total. As all separations of the metal from its accompaniments on a large scale are imperfect—if we except the method practiced at Oker in the Hartz mountains—the finer particles escape. These are therefore contained in the tailings. Atmospheric action, chemical decomposition and the electric currents which they produce, are the probable causes of that agglomeration, which renders the gold, after a protracted period, sufficiently coarse to become again available to the amalgamator. To such an explanation, at least, we are led by observing the fact of the accumulation of the metal around roots; although this might point also to the possibility of the existence of a natural sulphuret of gold, disseminated in infinitesimal particles in the iron (or copper*) pyrites. The sulphur of this (and consequently its presence likewise) analyses could not possibly detect, owing to the far greater quantity of sulphur in the pyrites. If this be the case, the gold might have been separated in consequence of its coming in contact with carbonaceous matter, in the same manner as an oak-leaf was coated with copper in the Langheck near Weilburg, in Nassau, (in Professor Sandberger's collection at Weilburg.) Breithaupt, in his Paragenesis, mentions somewhat similar cases of the formation of iron

* I have in my possession a beautiful little specimen of malachite from the McGin Mine, in North Carolina, in which a few particles of gold of some size are distinctly discernable, thoroughly imbedded in the copper ore. As this gold is far removed from any ferriferous mineral, the specimen proves with much greater distinctness than the most careful analysis even, that copper pyrites (the source of the malachite) was the original matrix of the gold. Another specimen, equally instructive and illustrative of the same fact, I found in a parcel of copper ores sent me from Abbeville District (Sleepy Creek post office) by Mr. Alexander Dorn. Both these specimens fully and perceptibly establish the fact, that the copper pyrites is itself often auriferous. In cases like the cupriferous and auriferous slate of the Gold Hill Mine, N. C., and the copper bearing gold quartz of veins of the Carolina group, we might generally be led to suppose that it is the accompanying iron pyrites only which is the real matrix of the gold.

pyrites, pp. 21, 22. Perhaps, also, the increase of the particles of gold in size, may have been effected by the simple force of aggregation, producing a translocation of the particles (Paragenesis, p. 23). These hypotheses as to the cause may perhaps long remain uncertain. They may, however, serve to induce farther observations. For the present it must suffice, that the facts, for the explanation of which they were offered, are certainly such as they are represented to be, and that the discharge of the sulphur from the pyrites, and a consequent exposure of the gold to the action of the mercury, is not the only change effected in such cases.

In the following description of the deposits, those only have been enumerated which are of sufficient importance to be mentioned separately, or those few where the veins, whence they were derived, have not yet been opened or have no sufficient points of interest to have been treated in describing the veins. The others have already been mentioned under the head of the vein mines in connection with their mother veins, for it would have been injudicious to divide the description of one and the same mine, to suit the character of its respective parts.

The *Martin Mine* is situated on the waters of Wolf creek, in north-western York, and is the most extensive deposit I have yet seen in the State. The area of the gravel bed is about four acres, its greatest depth twelve feet. Its shape is oval, the broad part being on the north-west. The longest diameter is from the N. W. to S. E. The underlying slate forms a ridge in the centre, so that the deposit has filled two distinct depressions, its depth over the top of the dividing ridge being but one or two feet. Towards the sides the deposit thins out entirely, but the surface is almost everywhere auriferous.

The material forming the deposit is gravel and white pipe-clay, in alternating layers. The gravel consists of rolled quartz, of which some pebbles are half a foot in diameter. Ordinarily the size is about three inches, and decreases from that down to half an inch. The quartz is white and saccharoid, and, therefore, if it had ever been intended to work the mine properly, these pebbles should have been

crushed (see sugar quartz veins). The operations have, however, been confined to washing the gravel. Some few pebbles of more crystalline quartz are seen, but these contain no gold. The pipe-clay, even when perfectly free from all perceptible quartz particles, is highly auriferous, and my pannings gave most favorable results, although the unctious character renders it troublesome to pan and necessarily causes a loss of gold.

The almost total absence of all coloring matter (hydrated peroxide of iron) is a noticeable peculiarity of this mine.

This deposit was derived from veins which crop out close at hand. Some of these are represented in Pl. IV., fig. 5, where "A" is the talco-micaceous slate country, "B, C," the veins, and "D," a part of the deposit. Other veins show themselves on the hills around. As the original source lies so close at hand, a powerful gyratory motion must have been exerted to round the pebbles to the extent in which they are now seen.

This mine was first worked about 1836 or '38, by Daniel Smith and Dawkins, who obtained a lease for ninety-nine years from Martin. This lease has repeatedly changed hands, and the mine is still worked upon it. At the time of my visit, two and a half hands only were occupied there. The gold is coarse and easily obtained. Large particles, of the size of a pin's head, are common, and nuggets weighing seventeen ounces and nine and a half ounces have been found. One piece of quartz, about one quarter cubic foot in bulk, contained 210 pennyweights, another over 4,000. In May and June, 1852, Messrs. Beam, Gill and Allison, with the labor of two men and two boys, and the use of rockers only, made $5,700 worth of gold. But for a short period only was a drag mill ever at work here; otherwise rockers have alone been employed.

The gold is worth ninety-eight cents per pennyweight.

The *brothers Belk's deposit* is situated in Lancaster District, a mile or two north of the road from the Court House to Taxahaw. It was a complete surface deposit, about two feet thick at the deepest part, and covered a quarter of an acre only; yet it yielded with four hands during two months, the sum of $6,000. At present it

is entirely exhausted. The purity of the gold was seventy-three per cent., much silver being present. The value of the latter metal, obtained from the whole, was $200. Farther searches were unsuccessful, except in the discovery of the lenticular veins already mentioned.

Some deposits of gold, which are, however, unimportant, are found near Chesterfield Court House. The most prominent of these is on Mr. Craig's and Mr. River's land. But even they are shallow and inextensive. As long as they last, they may, however, be profitable. At Mr. River's place some veins also occur, which will certainly yield copper in depth (see copper).

Westfield Creek Deposits are likewise in Chesterfield, and are situated north of Cheraw, near the North Carolina line. The deposits contain a great abundance of tertiary pebbles. Whether the origin of the deposits themselves is referable to that geological period, or whether the pebbles occupy a position different from the one assumed during the period of their formation—in which case the deposits would be more recent—it is scarcely possible now to determine. The deposits contain no substances that could positively indicate a later origin, and as the character of the deposits strictly corresponds in all respects with other decidedly tertiary gravels of the District, there is certainly no sufficient reason to imagine a more recent source.

The gravel bed contains much clay. The gold is coarse, as might be expected. The work performed here is very insignificant, and is confined to occasional washings by the poor inhabiting the neighborhood. Long ago Mr. Blue, at that time the proprietor, made some practical explorations, which, however, were not long continued.

To enumerate all the deposits along branches and elsewhere in a district like York, for instance, would alone fill a volume; for, in the north-western part of that District, there is scarcely a water-course whose sands do not contain more or less gold (see geognostic sketch of that region in this report). The deposits here mentioned are all of those whose importance is sufficient to demand our attention in these cursory observations.

COPPER.

This metal is entirely new among the discovered minerals of our State; and, as there are numerous unexplored mines of this metal, some of which are of the highest promise, the subject merits our especial attention.

The area of the occurrence of this metal extends, it would seem, over the whole of the up-country, in other words, over the entire portion of the State which contains those rocks, in which alone we could expect to find veins of this metal, and indeed of any metals at all. Thus, in the course of this year's survey, I have found copper in York, Lancaster and Chesterfield, while about a year ago Mr. Friedeman (then in the services of a Charleston company operating in Pickens), discovered the metal in that District. Cupriferous specimens have also been sent me from Abbeville, and my attention was kindly called last winter to the presence of a small quantity of copper pyrites in a little quartzose vein of the granite at the quarry of Messrs. Green near Columbia. This was too small, however, to be of more than scientific interest. Still, it forms a valuable link in determining the area of distribution of this metal in South Carolina. In Union, Spartanburg and Greenville, copper has also been found.

It would certainly be an absurdity—an unwarranted stretch of the imagination—to term every occurrence of copper a copper mine; for the metal is found occasionally in rocks, where there is no possibility of discovering it in any available quantity. Thus crystalline slates often contain particles of the metal, without affording any reason to expect a greater amount (Alabama). In York I also found copper in the limestone. Nevertheless these occurrences are indications, in a general way, of a cupriferous region.

Unfortunately the existence of copper in the State has not yet received a sufficient appreciation from men of capital to further the necessary explorations in the proper manner. The novelty of the investment and an obvious aversion, readily to be understood, it is

true, to place the necessary confidence in those whose studies and whose profession supply them with the best means of arriving at correct conclusions, has hitherto placed a barrier in the way of opening our copper mines. Where attempts have been made to explore their contents, the insufficient means of the proprietors, or the fact that advice from competent persons was disregarded, or that this advice was sought from those whom want of experience rendered incapable of supplying it, have been the causes of whole or partial failure. Still, it must be evident to all, that if the results of this survey are to be of value to the State, energetic individual enterprise must avail itself of the discoveries made, and it is to be hoped that the State itself can supply this without having recourse to that derived from a foreign source. The increased value of copper should serve as an additional inducement, especially as the United States are obliged to import (chiefly in pigs from Chili), one-third of the copper consumed. Ores always find a ready market at American furnaces, as well as European ones, at Swansea for example. Thirteen thousand tons of the metal were produced last year at all the American furnaces. This is, however, only about a fifteenth part of that smelted at Swansea, in England.

A large class of our gold veins become copper veins in depth, the ores of lead occurring sometimes, though not always, between the two. While engaged in the geological survey of Alabama, I had occasion to observe facts in regard to this, which, when viewed in connection with analogous cases here and in North Carolina, led to the suggestion of a theory, which I explained in an article in the New York "Mining Magazine," of October, 1855. Professor Cotta, of Freiberg, at a meeting of the association of miners and geognosists, read an abstract of the paper, which appeared also in the "Berg and Huettenmaennische Zeitung" of the 2d of April, 1856, adding some remarks of his own. It was interesting, after writing the article, to find in Cotta's "Lehre von den Erzlagerstaetten" * p. 44, an ima-

* This work appeared in 1854 and 1855. The remarks in it, and in the article already mentioned, were based upon independant observations, a fact which increases the probability of their correctness.

ginary case mentioned (no actual instance of which he was enabled to adduce) which served as an explanation of cases of the kind.

Figure 4, on plate I, is the same which was first represented in the "Mining Magazine," and the advantages of continued observation have led me to regard it as correct in the main, although it would appear from the Johnston Mine (q. v.) that the ores of lead may be replaced by other metals.* This drawing does not represent a section of veins, actual or ideal, but is intended to render more plainly visible the varying features of different veins of the same class, influenced by different surface levels and by a locally distinct, though analogous, distribution of the contents. It is therefore, what might be termed a *schematic* drawing ("schematische Zeichnung," Cotta terms it), if the coinage of a new word is no inexcusab offence.

In this drawing "D E" represents what may be considered to have been the original surface of the vein out-crops (not of the country, for the sketch does not deal with the country rocks at all), while "D F" is the line which marks the level of the outcrops as they now appear—the upper parts having been removed by the destructive agencies of water and of atmospheric action. "A A" is the portion occupied by auriferous iron pyrites, and, when the pyrites is decomposed, by auriferous hydrated peroxide of iron. It is the gossan of the vein, and wherever the line "D F" rises above the lowest level of "A A" the veins (which are marked "*a, b, c, d,*

* Professor Cotta, in remarking upon the paper already mentioned, observes, that the presence of lead in such veins occasionally, though not regularly, should refer them to different groups, I having suggested, that their irregular accompaniment of lead might be ascribed to a casual introduction of salts of lead into the solution, from which the gangue and ores were precipitated. It is perhaps not yet laid down with sufficient definiteness, what difference of character constitutes a separate class of veins. At all events, the opinions of that eminent geologist are regarded by me with too much respect to permit me to pass them by unnoticed, even though this is an official report and not a scientific dissertation. Nor would it be dealing candidly if, in support of his conclusions, I did not again call attention to the Johnston Mine, where, if copper be actually found in depth, as it is anticipated, we would have an instance of the replacement of the ores of lead by those of manganese.

e,") possess an auriferous gossan. The wedge-shaped portion "B" is the region of lead, its form being intended to indicate its irregular and variable presence; for, in most cases, I now find that this metal is omitted. "C C" is the part of the veins occupied by the copper, which generally touches the area occupied by the gold-bearing gossan, owing to the frequent absence of the plumbiferous region.

In this theoretical section we find a complete illustration of all the cases that may present themselves to the observer, in the class of veins we are now discussing. Thus, "*a*" and "*b*" represent in its different parts the vein of the well known Morgan or Leitner Mine, near Limestone Springs, in Spartanburg; while "*c*" and "*d*" exhibit the character of the veins of the Brewer and Edgeworth Gold and Copper Mine in Chesterfield; "*d*" is likewise explanatory of the Hagin and the Wilson Mines—the former in Lancaster, the latter in York; while finally at "*e*" we find a vein with no auriferous iron pyrites remaining, and where, therefore, lead being absent, the copper zone is struck at the surface, as is the case at the Mary Mine, in York. As the same vein is seen at the Wilson and the Mary Mines, this drawing—if regarded as a longitudinal, actual section of one and the same vein—is capable of explaining the reason why, owing to different levels of the surface, the self-same vein may be at one point, that is to say, close to the surface, a gold-producing vein (as at the Wilson), and at the other, altogether a copper vein (as is the case at the Mary). It shows also, collaterally, how at the latter a great advantage is gained for mining operations; for in this instance it is not necessary to penetrate through comparatively unprofitable (i. e. auriferous) portions of the vein, before the less valuable, but more productive metal, copper, is reached.

This is the same class of veins which, in regard to its auriferous contents, was first noticed among the gold veins, where many of the mines belonging to it were discussed. For the sake of convenience in reference, the name of the "Carolina group" was proposed for it, as was that of the "Ducktown group" for another class of copper veins to be mentioned hereafter.

The mines of the Carolina group, which demand our more imme-

diate attention, are the Mary Mine, the Wilson Mine, the Smiths Mine and the Sutton Mine, in York, the Hagin Mine in Lancaster and the Brewer and Edgeworth Mine in Chesterfield. All but the first have been described under the head of gold, although some of them, if not all, will doubtlessly prove, at a future day, more productive as copper mines than they have been as gold mines. The Mary Mine is therefore the only one to be spoken of here.

The *Mary Mine* is situated in York District, four miles and a quarter north-east of the Court House. The vein, as already observed, a southern prolongation of the vein of the Wilson Mine, is a contact vein between a porphyry dyke and the mica slate, the porphyry itself being a contact dyke of the granite. The latter is here of a gneissoid character, although this peculiarity is quite local. At one point the porphyry spreads out on both sides of the vein, as is shown in Pl. IV., fig. 8, a transverse section of the vein and country rocks, "A" being the mica slate on the east side, "B" the gneiss on the west, "C" the porphyritic dyke and "D" the vein.

The strike of the copper vein is N. 25° W., its dip about 85° towards the N. E. The quartz of this vein is of a remarkably fine crystalline character. The copper pyrites, protected from decomposition by the constant water of a little stream, which runs over the outcrop of the vein, is found immediately under the surface. A small exploring pit, seven feet in depth, which was sunk at my direction, produced native copper. The proportional increase in width, per foot in depth, is at that place, two-sevenths of its width; for, commencing with half a foot at the surface, it widened to two and a half feet in a descent of seven feet. Ordinarily, the width at the surface is three feet.

This mine has as yet been unattended to, but I trust it is not too bold to promise that it will not long remain so; for indeed it would be difficult to discover finer prospects for a copper mine, or a location more favored with the conveniences of a railroad for the transportation of the ore or pig metal. I do not hesitate to express my conviction, that not only is that day close at hand, when explorations, carried to a proper depth, will fully develope the character

of this mine, but that the period is scarcely more distant when it will add a most important item to the exportations of our State, and prove the initiative cause of a more extended commerce, while, at the same time, the good example given by a well conducted and profitable mine, will give a new impetus to honest mining enterprises.

Besides the vein already mentioned, there are others at this mine, two of which are eighteen feet in diameter; the one striking N. 80° E., and therefore meeting the main copper vein, the other N. 37½° E., and consequently crossing the first as well as the copper vein. These veins, in all their characteristics, strictly resemble the veins at Mr. Morgan Dover's, on Wolf creek, in York District. For the present, it must remain unsettled whether these veins should be regarded as belonging, strictly speaking, to the Carolina group, although they are also auro-cupriferous. At all events, it is proper to consider them as a distinct subdivision of that group, for the same reasons which, when treating of their character as gold-bearing veins, induced a separate classification (see gold veins). Nevertheless, as these instances are quite isolated, it is necessary to avoid too great precipitation, and to await the results of more protracted observation.

Instances of these veins, we find at the Mary Mine and at the Morgan Dover Mine. All consist of a saccharoid quartz. They are likewise auriferous, and, though they contain copper, the ores of this metal appear scatteringly, disseminated in minute particles, and not in the massive manner in which they are seen at the main copper vein of the Mary. Possibly the copper found in the sugar quartz veins of this mine may be erratic and derived only, by subsequent transposition, from the chief copper vein. To judge from the analogy of these veins with other sugar quartz veins (which, it is true, are auriferous only), known by experience to cease upon striking the hard country rock, their value becomes doubtful. Still, it would be wrong to pass final judgment upon them without a previous careful observation of their character in depth, for which the limited mining operations of our State do not, as yet, afford an opportunity.

Allusion has already been made to that class of veins which appears at Ducktown, in Tennessee, and extends south-westward into Alabama, and north-eastward into Virginia, through the valley which separates

the Blue Ridge from the Alleghanies. Its characteristics are a porphyroid mixture of iron and copper pyrites, the latter being the matrix, though the cubes of the former exceed it in bulk. The porphyroid structure is singularly distinct in some of the Georgia mines; for in many of the Ducktown ores, this otherwise unusual, relative position of the two minerals does not exist. The composite mass fills the vein crevices to the almost entire exclusion of other minerals, which usually abound in veins, though sometimes we find quartz on one or both walls. Owing to decomposition of the compound ore, the upper part of the veins consists of impure peroxide of iron, whence the copper, as sulphate, was leached and deposited, with a partial formation of the black oxide, in the lower part of the decomposed area, and therefore immediately above the unaffected sulphurets. Here then we find a richer ore, owing to this natural concentration, than immediately below it. It appears, however, from recent explorations, carried on by English companies, at Ducktown, to a depth of 350 and 400 feet, that a gradual increase in the value of the ore takes place in descending, and, indeed—if we may apply the evident rule of the veins of the Carolina group to this class also—a diminution of the quantity of iron pyrites, and an increase of that of copper pyrites in depth, was reasonably to be expected.

Whether this Ducktown group is absolutely confined to the valley between the two chains of mountains, already mentioned, the future must decide. Hitherto no veins, petrographically synonymous, have been found beyond its bounds. There is, however, on Nanny's mountain, in York, the gossan outcrop of a bed-like vein, which, from the great similarity of its constituent iron ore with that of the established cupriferous veins of this class elsewhere, has led me to suggest the great probability of the future discovery of copper at that place; although the experienced vein geognosist will discover an objectionable feature in the fact, that the vein outcrop forms the backbone of a mountain of some prominence, when compared to the ordinary surface levels of the adjacent lands.*

* I do not offer an explanation, but merely state this as a generally observed fact.

Like the gossans of Ducktown, the upper part of this vein was worked for iron ores in former times, the furnace, which was supplied by it, being indeed the first erected in South Carolina. It was established by Col. Hill and Wm. E. Hayne, prior to the revolution, and, being employed in casting balls at the time of the war, was burnt by the British on their route to Charlotte. Bloomeries were afterwards built here, but it is now already more than forty years since the company failed, owing as well to an inferiority of the iron as bloom iron, occasioned by the same hardness which rendered it particularly suitable for certain castings, as also to the greatly decreased quantity of timber for fuel in the neighborhood, and the expense of transportation.

The gossan of the vein most remarkably corresponds in its constituents with the porous hematites, which cap the veins of the Ducktown group. It was this feature which first led to the surmise, that possibly this case might overturn the previously formed opinion, that the veins, which correspond petrographically with those of Ducktown, are geographically confined to the long valley region already mentioned. In this case, South Carolina would after all not be entirely excluded from veins, which, though remotely separated from the rest as to locality, are synonymous in internal features. In a case, however, which is so entirely new, it is best to await the certain decisions, to which actual underground explorations alone can lead, since definite conclusions, based upon analogies with established ones, are impossible. As the mountain on which this vein occurs is very precipitous on the side towards which the latter dips, a level at a great distance from the outcrop might be driven, which, without the inconvenience offered by much water in a shaft, would soon strike the vein, and determine its character in depth, at a comparatively small expense; while the great value attaching to so important a discovery of copper ought to be a sufficient inducement for the undertaking.

Plate II, figure 2, furnishes a section of the vein at the principal excavation on the top of the mountain. In it "A B" is the vein, "B" being the part worked out as an iron ore; "A" a portion of the unexplored region, which, as the part exposed indicates, forms

a bench. "C" is the gneissoid country. The measurements are given in the sketch, so that it is unnecessary to state them here.

The strike of the ridge of Nanny's mountain, with which that of the vein corresponds, forms an S. Commencing on the south, we have the following succession of strikes: N. 31° E., N. 10° E., N. 5° E., N. 28° W., N. 37° W. This is the termination of the mountain on that side. The vein, however, continues striking first N. 10° E. and then N. 45° E., after which it is cut off by a dyke of syenitic porphyry (quartz and hornblende). The dip of the vein varies in direction, of course, in the same manner as the strike; being first, S. 59° E., S. 80° E., S. 85° E., N. 62° E., N. 53° E., and afterwards, S. 80° E., and S. 45° E. The angle of dip is variable, but ordinarily very great.

LEAD.

This metal I have not found extensively in any part of the Districts hitherto surveyed, although of others, Spartanburgh for instance, a very different remark must be made. The actual discovery of lead ores is confined, but there is at least one case, at Mr. Stroud's, in Lancaster, which, although unexplored by mining operations, affords indications that point to their existence in great abundance in depth. Other places, where lead occurs, are at the Pott's Mine, in Lancaster (q. v.), and at the Brewer and Edgeworth Mine in Chesterfield; while lead is said to have been found in a six foot vein on the land of Johnathan N. Stuart, near the King's Mountain battle-field, a vein which abounds in fibrous black hematite. Lead is also reported to have been discovered by the Dovers on the Silver mountain near Dolittle creek, in York, though there is reason to believe that this arose from a mistake, occasioned by a slate bed abounding in iron pyrites, which was observed there. That, however, this portion of York should contain lead is far from improbable, as we have the Morgan Lead Mine in Spartanburgh, and as galena has been found in isolated pieces on the property of the Swedish Iron Manufacturing

Company in the corner of Union; while I discovered this ore at Brigg's Gold Mine, in North Carolina, close to the York line.

At John H. Stroud's, Esq., in Lancaster, (marked Yarborough on Walker and Johnston's map of the State,) we find a collection of veins which we must not overlook in speaking of occurrences of lead. The character of one of them, which strikes N. 74° W., from its similarity with that of the Morgan and the Pott's Mine, having induced me to express a conviction that lead would be discovered, it gave me pleasure to find the opinion verified by noticing some soon after. This is, however, neither the main vein, nor the one which gives the best promise for lead. The most important one, striking N. 10° W., cuts off the other. This vein may be traced for one and a half to two miles, and, at its northern termination on Mr. Stogner's land, it forms a large outlying outcrop. Everywhere this vein presents the same petrographic features, which serve as very decisive marks of distinction. The quartz which, at the surface, is amorphous, is traversed in every direction by minute veins of crystalline quartz with distinct concentric crystallization. These often present beautiful little slides, and afford cabinet illustrations of a variety of the phenomena observable with veins. Their presence is to a great extent, if, indeed, not altogether, owing to the removal of substances formerly existing in the matrix, whose absence produced cavities and seams. Of these calcspar was one; for the spaces now vacant, which were occupied by this mineral, are often distinctly discernable on account of its crystalline forms. Quartz of this description, especially when, by the cavities left, it proves the original presence of calcspar, so common a companion of lead and silver ores, must be viewed as eminently favoring the supposition that these metals will be found below. There are ample grounds for the conviction that the future will prove such to be the case with the first metal at all events. This vein will, however, certainly show itself entirely different from those of the "Carolina group." The principal vein here is less accompanied by a ferriferous outcrop than that which strikes N. 74° W., but which is evidently a minor vein, and but little more important than a similarly striking companion vein close to it.

MANGANESE.

Of this metal no deposits of technical importance have yet been found, although the existence of a manganesian bed in the talcose slate of King's Mountain, already described by Mr. Tuomey, and of the pyrolusite in the quartz vein of the Johnstone Mine, (q. v.,) are noticeable facts.

BISMUTH.

This metal was discovered by Mr. Tuomey at the Brewer Mine, both native and in the form of a carbonate. Unfortunately, when I visited the mine, the shaft in which it was found had been allowed to cave in, so that no observations of its position and modes of occurrence could be made.

Professor Rammelsberg, of Berlin, in his dictionary of chemical analyses (4th Supplem. p. 262), gives the results of an analysis of the carbonate of bismuth, which he terms bismuth spar, the specimen being from this mine, presented to him by me. These were:

Oxide of Bismuth	82.63
Perox. of Iron	2.55
Alumina	1.79
Lime	0.28
Magnesia	1.60
Carbonic acid	6.02
Silicic acid	2.97
Water	3.16

Dr. Genth informs me that he found traces of tellurium, and hence regards it as derived from tetradymite.

IRON.

This metal is met with in workable quantity only in York, though ores of it have been found elsewhere. Thus a deposit of bog iron ore occurs on the Steel Creek road near Cureton's Store, north of

Lancaster, and some fine magnetite appears inextensively in north-eastern Chester, not far from Moffat's store. Magnetite also abounds in the porphyroid and trappean rocks of Chester and York, sufficiently so, indeed, to affect the land surveyor's compass in running out long lines, though disseminated through the mass of rock in such minute particles that it is not of any practical value. At Nanny's mountain amorphous porous hematite was once employed at the furnace there, but circumstances, chiefly unconnected with the value of the ore, have induced its abandonment (see "Ducktown group" of copper veins in this report). On the waters of Wolf creek, in north-western York, specular schist beds were formerly worked, and the ore smelted at Stroud's furnace, which has long ago ceased to operate. The only occurrences of iron ores at present practically important are, therefore, confined to the corner of York, west of King's Mountain and its southern prolongation.

With regard to the ores, the mines may be separated into those of magnetite, of specular ore and of hematite, a division of importance in the eye of the smelter, although petrographically the distinction need scarcely be made, as the changes are here probably all induced by secondary action, and are, therefore, chemical alterations of the same substances in the same positions.

Perhaps, as will be seen from the following remarks, it would have been more systematic to treat the rocks—for such they are—which are there worked as ores, in the chapter on the general geognostic features of the region. A desire only to include all the useful minerals in the present chapter causes me to introduce their description here.

Most important of the ores, in a geognostic point of view, is the *specular schist** (siderocriste, Eisenglimmerschiefer, fer oligiste micacé), for in it another companion of the itacolumite may be added to the list, which produces so great a similarity between the occurrence of that singular rock in our State and in the Brazils. Such comparisons are not only interesting, when scientifically regarded, but as they tend

* A name suggested to me by Professor Dana.

more perfectly to establish the character of a country or a formation, they often lead to deductions, whose practical value is apparent. In the article on the itacolumite in the second chapter, a comparison between its accompanying rocks here and in South America, is instituted, and it will, therefore, at present be necessary only to describe the specular schist.

This rock, which is so exceedingly rare—for the only localities hitherto described or mentioned are in the Brazils, Marmoras and Provence—as shown by the section of the region, from King's Mountain eight miles west, on plate V, appears in beds intercalated between the talcose slates. As true specular schist, the Bird bank or specular ore bank can alone be named. This is seen at various points between the western declivity of King's Mountain and the southern lime outcrop, extending thence south-westward to the two ranges of hills which bound the Dolittle (or Dearlittle) creek—the Dolittle and Silver mountains. On the former of these the outcrop is wider than at any other point observed; for they have already quarried across it thirty-five or forty feet, without meeting any interruption. Indeed, the whole of the hill consists of alternating beds of quartz, talcose and specular schists. The greatest thickness of the latter is between the itacolumite and talcose slate. The strike of these beds is N. 41° E., the dip 64½° S. 49° E., but, owing to folds of the rocks, some quartz beds strike N. 5° E., and some of the talcose slate N. 11° E., both being vertical in dip. The interrupted extension of the beds of the specular slate north-west and south-east at this point, is about half a mile, though in its north-eastern prolongation it gradually becomes narrower, until east of the place of A. Harding, Esq., it finally gives out.

On the Dolittle mountains we find this remarkable rock not only most perfectly developed as regards extent, but also most strongly marked in its peculiar petrographic characters. Here it presents so great a similarity with some micaceous schists, that, at first sight, few would suppose it to be anything else. In color it is steel-grey, but its crimson streak, when scratched, distinguishes it from mica-slate, to which it possesses a resemblance in the laminated or scaly

nature of the individual parts of the iron glance. Sometimes, especially farther north, this feature disappears to a considerable extent, and the rock becomes less schistose and granular, owing to the shape of the minute crystals of the iron ore. In these cases talc generally enters more conspicuously into the composition of the rock, and, owing to the presence of a small admixture of magnetite, it becomes slightly magnetic. As an ore this rock is greatly valued at the furnaces, though not used to any extent at the bloomeries.

Where atmospheric action has been able to effect the rock, the specular iron (anhydrous peroxide) is converted into earthy hematite (hydrated peroxide). This generally forms as a crust, and the mass contains harder nuclei. We shall have occasion again to return to this ore.

The magnetic iron beds of this region seem to be synonymous with the *itabirite* of Eschwege, although in South Carolina the quartz is present in less quantity, and the accompanying talc greatly increased in amount beyond what, according to description, seems to be the case at the Peak of Itabira, the Sierra-da-Piedada and other Brazilian localities. With us the rock essentially consists of talc (or chlorite) and crystals of magnetite, the former being the matrix of the latter, while talcose strata, less admixed with magnetic iron, are intercalated between the others. These do not affect the needle, while the former are highly polaric. Wherever I have examined beds of this rock, as for instance at the Lee and Parker bank and the ore beds of the Swedish Iron Manufacturing Company in the corner of Union, (both of which are outcrops of the same bed,) dykes of melaphyre or of diorite appeared in the immediate vicinity; so that it is not impossible, that the magnetite may have resulted from a partial reduction of the peroxide of iron of the specular schist to a protoxide.

This rock also occurs at the junction of the itacolumite and talcose slate, and, therefore, gives additional reason to regard it as a continuation of the specular beds, although separated from it superficially by the itacolumite. At the Lee and Parker ore bank it is immediately underlaid by a barytic vein, the width of which has not yet

been determined. The heavy spar, likewise, appears as streaks or intercalations, and the vein also cuts off the ore bed occasionally, and may, perhaps, have been the means of the introduction of that sulphur, which has converted the magnetic bed into a pyritiferous one at a depth rarely exceeding sixty feet. Accessory minerals which are found there are: mesotype, hyalitic quartz, chlorite, very pure talc, asbestus, staurolith, and, owing to the decomposition of the pyrites, sulphate of iron.

The strike of the bed at the Lee and Parker bank is N. 47° E., its dip 60° S. 43° E. The bed continues, with one or two apparent interruptions, and crosses to the east of the summit of King's Mountain in North Carolina. That this interruption is a seeming one only, and altogether confined to the surface, is decisively evinced by a most singular fact. When Briggs sank a deep pump shaft at his gold mine in North Carolina some years ago, the works at the Parker, as well as the Lee bank, at least thirteen or fourteen miles distant, were entirely drained, filling again when he stopped his pumps and draining a second time, when Commodore Stockton put them in operation again. The connection would appear imaginary, notwithstanding this remarkable fact, as the gold vein of the Briggs' Mine lies to the west of the iron bed, and as this bed at the ore banks dips S. E., but such cannot continue to be the case, when we recollect that in North Carolina the beds on the west of the mountain range dip N. W. They thus form, in their north-western prolongation into our State, a saddle-shaped alteration in dip, which admits of an easy explanation in the folds of the rocks, (as shown on plate V,) of which this region is constituted.

As an ore, this itabiritic rock has long been appreciated, and will continue so until the destruction of the forest growth—no remedy for which has hitherto been attempted—will render the charcoal used too expensive to prosecute the manufacture of iron with advantage. This fatal result can be avoided only by a thoroughly organized cultivation of woods.

The ores of this region yield a steel which is probably unrivalled

even by that derived from Swedish iron, and their fame has already extended to England, where a company is now contracting for the purchase of the property of the works.

We now arrive at the *hematite* beds, which sometimes, owing to admixtures of breccia of magnetic iron and iron glance, exhibit a similarity with Eschwege's South American *topanhoacanga*. Where this is the case, the composition not only, but also the position, is ascribable to secondary action. Of technical importance are those beds alone, which still retain their original position, and whose present composition is the result of the assumption of water by specular beds, or the additional partial oxydation of magnetic ones.

Beds of this amorphous hematite are seen on Whitaker's mountain, on the western slope of King's Mountain, (a continuation of the specular schist probably,) on the south of the southern lime, and occasionally between the two limestone outcrops. The former have alone been worked to any extent. The first is termed the Harding bank, the second the Bird bank. The Harding bank is the one which demands our most particular attention. On plate II, figure 4 illustrates the position of this bed, which indicated the character of the folds of Whitaker's mountain, exhibited in the ideal section, on plate V. In figure 4, plate II, "*a b*" is the surface of the mountain from west to east; "*c*" the ore bed, "*d*" an underlying stratum of kaolin* derived from one of the felspathic beds, so common in this part of the District, while "*e e e*" is the talcose slate. Figure 6, also on plate II, furnishes a view of the wall of one of the pits, and exhibits the variable character of the ore, the irregularity of some of whose folds may, with great probability, be referred to the chemical changes which have so very evidently taken place here. For instances of similar action see Breithaupt's "Paragenesis." In this section, which extends from west to east, and is drawn on a scale of two feet to the inch; "*a*" is decomposed talcose slate, and red clay (a part of what German miners term "Schweif," *tail*); "*b*," talco-micaceous slate, mixed with red iron ore; "*c*," compact

* Not overlying, as Mr. Tuomey has it.

red hydrated peroxide of iron; "*d*," cellular red iron ore; "*e*," more compact ore; "*f*," spheroidal ore stratum; "*g*," stratiform ore; "*h*," the kaoline bed; "*i*," compact black hydrated peroxide of iron, and "*k*," again ferriferous talco-micaceous slate. It is apparent, therefore, that in the disposition of the minor strata, composing the entire bed, it exhibits the utmost similarity with the specular and magnetic beds.

The strike of the beds is N. 30° E., the dip of the third part in figure 4, is 70° N. E., and of the two others west of it, 45° to 70° in the same direction. The eastern part of the bed is indicated in nature only by disconnected bodies of ore, of little practical value.

These beds are, like the others already described, placed at a short distance only from the itacolumite; and but little doubt can therefore exist, that the outcrops of all these (though distinguished by different ores of iron) really belong to the same original bed, and that a deviation from its original horizontal position has been the main cause in occasioning them to be considered as separate and distinct.

BROWN COAL OF THE CHERAWS.

The brown coal, or lignite, is found in beds belonging to the tertiary formation of Chesterfield. The principal locality observed is on Whortleberry branch, immediately north of Cheraw; although I also found some near Mt. Croghan. In sinking wells, others have discovered it in Marlboro', where indeed there is reason to believe the main body of the bed will be found. On plate II, sections of the brown coal bed on Whortleberry branch are given, figure 7 illustrating the removal of the main part (B) of the bed "A B C" by the action of the stream, "D;" while figure 7 shows the superposition of the different strata. The drawing is on a scale of twelve feet to the inch, and is sketched from the sides of one of the washes, where a severe rain has just admirably cleared the ground for observation.

In the latter section, "D" indicates the direction to Whortleberry branch; "*a b*" is the inclined bed of the wash or gully; "*c*" a marbled argillaceous sandstone, "*d d*" bituminous clay; "*e e*" brown coal seams; "*f*" the bituminized trunk of a tree, from which the largest specimen (2½ feet × 1½ feet × ¾ foot) was obtained, "*g*" yellow sand with small pebbles, "*h h*" accumulations of larger pebbles and "*i k*" the soil.

The succession and thickness of the beds is therefore as follows:

i k—soil.
g—yellow sand and small pebbles.
h—large pebbles.
g—yellow sand and small pebbles.
The thickness of these is variable, the joint thickness being from one to nine feet.

e—brown coal—1½ feet, but soon giving out.
d—bituminous clay—1 to 2 feet.
e—brown coal—1 foot to ½ inch.
d—sandy bituminous clay—3½ to 5 feet.

e—brown coal—1 to 8 inches.
d—bituminous clay—2½ feet.
e—brown coal—1 foot.
These three are irregularly defined, and the clay is more bituminous.

c—marbled argillaceous sandstone.

The highly bituminous nature of the clay, and the compactness and want of a distinctly ligneous character of some of the brown coal beds, obliges us to regard this discovery, not as an occurrence of isolated pieces of bituminized tertiary drift wood, but as portions of regular brown coal deposits. Upon the value of these it would in few countries be necessary to enlarge. The United States are, however, so extraordinarily favored with finer qualities of coal, that brown coals have been treated with greater contempt than they merit.

While writing this very report, I received a letter from an esteemed friend and fellow student, M. Furuhjelm, the chief mining engineer of the Russian American Company. Writing from Cook's Inlet, he informs me, that for about a year he has been engaged in opening out a brown coal deposit, to be possessed of which the company congratulates itself, as, by its means, they expect to establish an important coaling ground for the Pacific, and to supply the California market with a most necessary commodity.

In Germany especially, the production of brown coal is extensive and steadily increasing. Prussia in 1855 produced 2,126,113 tons, and in Nassau, a prominent portion of the inhabitants make their living by the brown coal mines of the Westerwaldt. From this region, notwithstanding obstructions requiring several expensive tunnels, a railroad is at present constructing for the sole purpose of transporting this useful fuel to the Rhein. Some years ago, when on a visit to Prussian Poland, I found an excitement prevailing, in consequence of the recent opening of brown coal deposits in the neighborhood of Radowicz, similar to that attending some of our most important gold discoveries.

Taylor, in his work on the "Statistics of Coal," p. 320, gives a list of all the known workable deposits, which it is, however, needless to copy here.

The heat produced by lignite is about a third greater than that of wood. It burns slowly, and is on that account much liked as a household fuel; the heat emitted being very equal and regular. Its slow burning, however, and the impossibility of increasing or decreasing the temperature rapidly, renders it inapplicable to smelting purposes in its natural state. The cokes are used in the duchy of Nassau, in some processes of the manufacture of iron, and the gas made from it is employed in refining iron at the famous works at Mægdesprung, and at a gas-puddling furnace at Ilsenburg. This fact collaterally proves its adaptability for the manufacture of illuminating gas. For steamboats it has been repeatedly used with advantage. Thus the oolitic lignite of the island Veglia, is excavated for the

use of the Trieste steamboat.* In Texas, Trinity county contains an abundance of brown coal, which probably already supplies the Galveston steamers. Its utility and especial fitness for this purpose has at least long ago been shown.†

When we take into consideration that our State contains no other coal, and reflect upon the great service of which the opening of a good brown coal mine would be, close to a navigable river, the Great Peedee, there is certainly ample inducement offered for the continuation of such explorations by private capital, which neither the character nor the limited means of the State survey would permit to be more than commenced. I allude, of course, to exploring shafts and to borings. In these, it should be recollected that a succession of beds very often exists, so that it would be injudicious to cease boring or sinking after the first bed has been struck. Far less noticeable surface indications have led to the discovery of valuable deposits; and it is, therefore, not extravagantly sanguine to express the hope, that the matter will not be allowed to rest as it is.

It may not be useless to state that the great abundance of iron pyrites in the clays of the brown coal, would be well adapted to the manufacture of alum.

CLAYS.

To enumerate all the localities where clays suitable for pottery are found, would be impossible. Some which are, however, not undeserving of attention, occur on King's Mountain, on Mr. Well's land. One of them, especially, is particularly well adapted to the manufacture of fire-proof crucibles, while a clay, which strongly resembles the famous one of Stourbridge—from which the crucibles, used in England in making cast steel, are produced—is found in nodules of great purity in the bituminous clay beds of Whortleberry branch.

* History and Description of Fossil Fuels, by the author of "Manufactures in Metal." London, 1841, p. 477.

† Silliman's Journal of 1837, page 216 and 217—a method for using brown coal for steam engines was invented by Dr. Kuphal.

The yellow clay of the melaphyre and porphyries, though tenacious from the moisture it contains, does not seem to be sufficiently plastic for the potter's use. Excellent bricks are, however, produced from it.

Two kinds of clay are used by the Catawba Indians for culinary vessels and for pipes. That employed for the former, is yellow and contains no organic matter, while that of which the pipes are made, is rendered grey from the quantity of comminuted organic matter, and is a deposit underlying the alluvial soil along the Catawba river. As these Indians are so rapidly dying out, that they will scarcely last another generation, it may be worth while to mention their process of working the clay, under the impression that it may interest some readers. The Indian pottery is the only visible remnant of the national peculiarities of these poor people, their present state showing a great degeneracy even from their original savage one.

The manufacture of pots and other coarser articles contains little of particular interest, but that of the pipes, in which they excel, is more interesting. These are rendered exceedingly light and porous by the burning away of the minute particles of carbon. The clay intended for them is first thoroughly kneaded, and then roughly moulded by hand into the shape intended to give it. The lump is then left till it has dried sufficiently to receive a more perfect shape with a knife and a smooth stone used for polishing. After this the two holes are made with a stick, and the unburnt, but otherwise finished pipe, is left to dry. When all moisture has been thoroughly removed, the pipe is warmed by the fire, and then covered with oak bark, a vessel of some sort being placed over the whole. A small fire is then built over all, and sustained until the inflammable gas has ceased to escape from beneath the inverted vessel, and the oak bark is therefore completely burnt. Owing to a complete saturation by carbon, the pipe is then perfectly black. It is in this manner only, that they color them so thoroughly.

Another clay is derived from the decomposition of the felspar of the quartz porphyry dykes. This is porcelain clay of an exceedingly fine quality, and is found chiefly in Chester, near the Court House, and also at Dr. A. Mobley's. That near Chesterville has already

been employed in the manufacture of some of the finest kind of porcelain for artificial teeth. It occurs in great abundance, and might be profitably used on a large scale. Felspathic beds, yielding a fine kaolin, also occur in north-western York.

BUILDING STONES.

Of these there are a number of peculiar beauty belonging to the granites, gneisses, porphyries and the new red sandstone. As their qualities have, however, been mentioned in speaking of the rocks themselves, a repetition would be caused if they were enlarged upon here.

LIMESTONE.

The same reasons which induced the description of the specular schist in this chapter, occasions the mention of the limestone also, while similar objections might also be urged against its introduction.

The limestone is found in north-western York, west of King's Mountain, overlying the itacolumite. Two prominent beds, or rather long extending outcrops, occur, owing to folds of the bed, as seen in the ideal section on plate V. Another outcrop, on the south-western termination of Whitaker's Mountain, Mr. Black has enabled me to point out. This is only twelve feet in width, though probably widening below as the section shows. The other outcrops, which have been quarried at various places for a long time, average both about half a mile across, where they are most extensive. The two limestone outcrops are separated sometimes by itacolumite, sometimes by the talcose stratum only, which immediately underlies the limestone; and, near Mr. Black's house, by clayslate, into which the talcose schist seems to pass locally. They unite into one before striking the river.

Beds of a fawn-colored talcose and argillaceous schist occur as intercalations. These are termed "fox rock," by those who quarry

the limestone. Their presence in the kilns is, of course, detrimental to the quality of the lime. The appearance of the latter is also somewhat affected by the occasional presence of pyrites. Of these, iron pyrites is the most common; but, at an old quarry of the King's Mountain Iron Manufacturing Company, I also found copper pyrites distributed in minute streaks in the limestone.

All remarks on the burning of lime and the improvements which may be advisable, must be deferred for the present, or this report might well be considered to exceed its legitimate size.

The main strike of the limestone is about N. 45° E., but owing to the folds, as shown in plate V, local variations are found both in strike and dip. Thus at Deal's the strike is N. 60° E.; at a quarry of the King's Mountain Iron Manufacturing Company, N. 51° E.; at Harding's quarry, N. 46° E., dip 81° N. 44° W.; at Mrs. Gunthorpe's the strike is at one place, N. 25° E., and at another, N. 62° E. At both points the dip is vertical. At Mike Hambright's quarry, the strike is N. 45½° E., dip horizontal; at Wissenant's quarry (now Thomas'), strike N. 25° W., dip 21° N. 65° E.

CHAPTER IV.

AGRICULTURAL.

The distribution and quality of soils in Chesterfield, Lancaster, Chester and York Districts—Tabular View—Alluvium—Tertiary soils—New Red Sandstone soil—Clay, talcose and micaceous slates soils—Soils of the Greenstones, Melaphyres and Trachytic rocks, (Blackjack lands)—Their characteristics—Composition—Faults—Remedies and Qualifications—The soils of the Granites, Gneisses and Syenites—Improvement by lying fallow—Cause of local bad quality—Modes of improving Agriculture in South Carolina—Errors committed—Draining, its advantages—Denton on Draining—The Government Loan in Great Britain—Improvements effected—Expenses, etc.—Different systems—Tile draining—Covered drains—Various Rules—Manuring—Its objects—Excrements of animals—Gall—Fæces, human, bovine, equine—Value of human fæces—Urine of mammals, of herbivoræ—Analyses of urines of Cow, Horse, Hog—Preservation of Ammonia—Injurious effect of Gypsum and Copperas—Fencing—Cost of fencing—Calculation for one hundred rails—Miles of fence in South Carolina—Cost of fences in South Carolina—Object of fences—Value of Live Stock in South Carolina—Number of Live Stock in South Carolina—Value of that portion of Live Stock which causes the retaining of the fence laws—Objections to the present system—Objections urged against the abolition of the present system—Prospect of abolition de se—Evil influence of denuding lands of forest growth—Meteorological observations—Professor Henry's letter.

It will be readily understood by those agriculturists who have at all made themselves acquainted with the general character of scientific investigations in agriculture, and more especially with the nature of the analysis of soils, why it was quite impossible that, during this year, analyses and other laborious laboratory experiments with regard to soils should have been effected, where all the duties of the survey devolve upon but one individual, and where it is essentially necessary, in following out the main object of the survey—the determination of the extent of our mineral resources—that as much time as possible should be spent in the field. This cannot be expected, for it would require ubiquity.* Equally important, however, with the chemical

* It is most earnestly to be hoped that hereafter our State will value the importance

analyses of soils are the geognostic-physical investigations of their local occurrence. Indeed, a simple analysis may represent a soil as of an admissable character, while the physical conformation of the surface of the ground, where the soil occurs, may render it worthless. We have instances of this kind in the so-called "black-jack flats" of Chester and York. But we shall return to these again. The geognostic and physical features it will, therefore, be proper to dwell upon to some extent, as well as upon some general improvements which appear of importance in the perfection of agriculture in our State. At the same time I would beg to remind the reader that this report is an annual one on the progress of the survey, and, that limited time in its preparation, as well as a desire not to exceed the legitimate bounds in its size, will occasion brevity in these remarks.

Of the utmost importance to the agriculturist are accurate geognostic maps of the various districts, and, indeed, only in this respect is a connection to be found between a geological, or to speak more correctly, a geognostic survey and an agricultural one. If these maps are superficial, no value can attach to them, and I have, therefore, sought to render them as perfect as possible. In the chapter on the general descriptive geognosy of the region surveyed this year will be found an explanation of these maps, and a description of the various rocks of the respective districts. We may, therefore, at once enter upon their bearing upon the soils, for the latter are but the results of the disintegration and decomposition of the underlying or adjacent rocks, to which more or less of vegetable mould has been added.

The following tabular view will be convenient in giving a general idea of the character of the soils derived from the various rocks and formations of these four Districts.

of such a survey sufficiently to increase the means and effective force of this department, as other States have done, in such a manner that analyses of minerals and soils, of which I have made a large collection, can be accurately made, and other important observations conducted, e. g. the meteorological ones, so urgently recommended by Professor Henry in a letter appended to this report.

TABLE *of the Characteristic Soils and Subsoils of the various Rocks and Formations of Chesterfield, Lancaster, Chester and York.*

NAME OF ROCK OR FORMATION.	OCCURRENCE AND EXTENT.	CHARACTERISTICS OF SOIL AND SUBSOIL.
Tertiary Formation.	Covering the main body of Chesterfield, and showing itself in the south-east corner of Lancaster. Its sands also cover other formations, locally at other points.	This formation is characterized by vast extents of sand, but rarely relieved by the appearance of white, yellowish or reddish, clays which alternate in narrow seams with the sand. Coarse sandstones or conglomerates occasionally appear on the surface, in which the cement is hydrated peroxide of iron. The tertiary regions are desolate in the extreme.
The new red Sandstone.	Only in a small portion of northern Chesterfield, along Clay creek.	The extent of this rock in our State is too slight to render its soils of importance. They are, however, admirably adapted to cotton, and have within the last few years risen in price remarkably.
Clayslate.	Northern Chesterfield and a small portion of south-eastern Lancaster.	This rock shows itself so rarely, except along water-courses, that its productions of soils in loco is slight, its contribution to the soils being rendered chiefly to the alluvial deposits. Its decomposition produces clays, and hence the subsoil is of a clayey character. Their color is generally yellowish.
Talcose Slate.	In Lancaster, York and north-western Chesterfield. But little in Chester.	The soils of this rock are thin, and possess but few regenerative principles. The soil is characterized by a very fine sand, producing much dust, but nevertheless lying very compactly. The subsoil consists generally of very saponaceous clays of a yellowish or reddish color.
Mica Slate.	In York and Chester it is most extensive, but is met with almost always where the granite comes in contact with the talcose slate. In some places feldspar abounds in the rock, and improves the soils produced.	The soils of this rock are on the whole better than those of the talcose slate, but they are rarely seen pure, being generally beneficially affected by dykes of dioritic and trachytic rocks. The subsoil is distinguished from that of the talcose slate by a redder color and by particles of mica.

TABLE *of the Characteristic Soils and Subsoils of the various Rocks and Formations of Chesterfield, Lancaster, Chester and York.*—CONTINUED.

NAME OF ROCK OR FORMATION.	OCCURRENCE AND EXTENT.	CHARACTERISTICS OF SOIL AND SUBSOIL.
Hornblende Slate.	Occurs surrounded and penetrated by granite in Lancaster near the Hanging Rock, also in beds in the mica slate regions, but not extensively in any of these Districts.	The soil of the hornblende slate is very fertile. The subsoil is generally of a very brilliant red.
Itacolumite.	North-western York. Very inextensive.	The soil of this rock is, beyond description, poor. Indeed, in its composition, silica and talc, it has nothing which could produce a soil of any value. Very fortunately, in an agricultural point of view, the rock is exceedingly rare, and no one is obliged to confine himself to the use of its soil.
Limestone.	North-western York. Very inextensive.	The soil of the limestone, though of course of a good quality, is so rare that we need not dwell upon it. It is dark in color and contains much lime.
Dioritic & trachytic rocks, Melaphyre, Chester porphyry, etc.	Chiefly in Chester and York; but also, though less extensively in the other two Districts.	The rocks produce what are locally termed the black-jack lands—perhaps, to the agriculturist, the most interesting of all the soil divisions. There are so many important points to be mentioned in reference to these soils, that it would be impossible to give a full description in this table. See therefore farther on.
Granites, Gneisses, and Syenites.	More or less in all the Districts. Granite in all. Gneiss in York and Chester. Syenite in Lancaster chiefly.	The soils of the granite rocks generally belie their appearance in a favorable manner, and produce much beyond what their appearance would indicate, and also generally revive rapidly. Where their sands collect in quantity, they yield, however, very poor soils.

The *alluvium* I have not thought proper to mention in this table, as it is not derivable from the decomposition of rocks below it or close at hand, but has been brought from distant and often very different regions, and moreover, contains much more organic matter than do the other soils. Its inorganic constituents are derived from a great variety of rocks, and hence it presents different characteristics in almost every locality. Under ordinary circumstances, we find the name of "bottom lands" given to every more or less level cove, where a few acres of flat land may be found. The soil in these consists generally of the washings from the hill-sides alone, and is hence ascribable in its origin to the adjacent rocks.

The culture of the extensive river bottoms is every day becoming more precarious and less certain in its results. Owing to increased cultivation of the higher regions, and the almost entire denuding of the surface from the protecting forest growth, the waters of every rain are carried into the branches, creeks and rivers, far more rapidly than was the case in former times, and hence the freshets are infinitely higher and the destruction greater. The beneficial results of annual inundations, which were the cause of the deification of the Nile, are not felt with us. Those overflowings there, were at regular periods. The crops were so planted, that the inundation could not injure them. The Nile brought with it a rich mud,* which (although it only added from two to three inches in the lower or northern, and four inches in the southern part to the depth of soil in every century) sufficed to cause this region to be regarded by the ancients as the granary of the world. Yet this deposit had of course to be carried away from regions farther south, and it is those regions which we must compare with the bottom lands of the Up-country, where the waters, not having widened enough to lessen the rapidity of their descent, tear away soil, subsoil, beds of clay and sand, and carry them forward, until in the Low-country—spreading over extensive swamps—the speed of the current is decreased, the suspended particles are precipitated, and an additional coat of soil is thus added.

* Ehrenberg has found that a large portion of this mud or slime consists of animalcules, the decomposition of whose bodies doubtlessly tends to enrich the soil vastly.

There, however, the high stand of the water, produced by these inundations, which have been increased by the removal of forest growth in the more mountainous regions, renders most of these lands unprofitable.

It is a difficult matter to make any calculations of the effect of increased cultivation in the interior upon the quantity of the inorganic materials transported by the waters of our streams. At some future day the present accurate observations of the United States coast survey may lead to determinations of the kind, as far at least as the contour of the coast is influenced. It has often been observed, that rivers which were clear and limpid when first discovered, are now turbid and muddy; a proof that an increased transportation of soil-producing materials is effected.

The *tertiary* soils in the region examined are for the most part very thin—so much so, indeed, that were the forest growth removed, we would soon see nothing but a vast desert. The growth, or at least that which, from its size alone, attracts attention, is almost entirely confined to long-leafed pine and blackjacks, the forked-leafed variety of which is most common; while the round-leafed species exists only in damp low grounds, and is hence regarded as characteristic of a comparatively good quality of soil. The soil is composed, to a very great extent, of a remarkably coarse rounded white sand, while, on penetrating downwards, we meet with alternating beds of clay, sand and gravel. The poverty of the soil prevents any great increase of population. Indeed, I travelled one road for fifteen miles from house to house.

The *new red sandstone* shows itself in the neighborhood of Mr. Ephraim Horn's, and thence extends some miles east and about one mile south, stopping on the land of Mr. Joel Brewer, Sr. As already remarked, it is very favorably regarded as cotton land, although only within a few years has attention been paid to it.

The soils of the *clay, talcose* and *micaceous slates*, as well as of the *itacolumite* and *limestone*, have already been sufficiently treated in the chapter on descriptive geognosy and in the tabular view. None of them are favorably known, except that of the limestone, which is

too inextensive to demand greater attention here. We will at once therefore enter upon the soils derived from the *greenstones*, *melaphyres* and *trachytic* rocks. We may distinguish the following chief varieties of such igneous rocks, which occur in this region, and give rise to soils but little different from one another, though possessing features that distinguish them very decidedly from the soils of all other rocks :

Aphanitic porphyry, Aphanite or Melaphyre, Diorite and Dioritic Slate, Trachyte.

Most conspicuous among these in extent, and hence, likewise, in its soil-producing capacity, is undoubtedly the porphyry of Chester and York. Melaphyre, diorite, trachyte, domite, egeran and phonolith, occur in more narrow dykes. The melaphyre is the most common among the latter; while very small dykes of egeran abound in York and north-western Lancaster, although too minute to deserve attention here. All of them are treated, petrographically, at greater length in the chapter on descriptive geognosy. We have here only to do with the York and Chester porphyry, and with the melaphyre, both of which produce a soil of the same general character, and give rise to those regions most conspicuously developed in York and Chester, which are vulgarly termed *blackjack lands*. A distinction is made between the *rolling blackjack* and the *blackjack flats*.

The main characteristics of these soils are a dark color (usually a rich chocolate brown, sometimes becoming jet black) and a yellow and exceedingly tenaceous clay subsoil. Beneath this again is found, at various depths, the decomposed rock, passing down through which, we arrive at the undecomposed rock, to which vulgarly the name of "iron rock" or "negro-head" is given.

This yellow clay is a peculiar and characteristic feature of the blackjack regions. Only where the rock is fully decomposed do we find it of a pure yellow, for it assumes a greenish color, where undecomposed particles of the black rock are mixed with it. This is particularly perceptible in the roads where the wheels of vehicles mix up the two very intimately. A block of exfoliating melaphyre in north-eastern York, on the road-side, near Flint Hill church, exhibited

this gradual decomposition of the rock, in its passage from green to yellow, more completely than any piece I have elsewhere seen, (see chapter II.) In winter, the highly tenaceous clay causes the roads to be very heavy, and much to resemble those through the prairies of Alabama and Mississippi.

The name of blackjack lands refers to the growth, and—although this tree is, as Mr. Tuomey remarks in his report, indicative of the presence of moisture rather than of a want of fertility in the soil—large portions of this region have for a long time been held in disrepute, undoubtedly more on account of the natural vegetation, than for any real demerit in the soil itself. An analysis of the soil, given by Mr. Tuomey, proves it to be possessed of high qualities, from which, however, the physical state of the surface frequently detracts very materially. The analysis of soil of this description from Chester, gave:

Organic matter	1.9
Silica	60.0
Alumina	20.5
Oxide of iron	8.7
Lime	2.9
Potash and soda	0.2
Water and loss	6.7
	100.0

I have collected a large assortment of these and other soils and subsoils for future analysis.

This blackjack growth is, however, not the original one; not the growth found here, when the white man first took possession of the region. Men are still living who recollect it to have been generally as bald as the prairies of the West, covered by grasses only. Gradually post oaks and hickories sprang up, in the same manner as the western prairies become wooded where they are not cultivated, after the settlement by the white man; a fact which is interesting in the study of the distribution of plants. It may, in part, at least, be owing to the discontinuation of the Indian practice of burning off

the grass in the autumn, to facilitate the growth of the young plants in the succeeding spring; a practice which is certainly inclined to retard or indeed absolutely prevent the production of perennial plants. These woodlands after a while, in the natural rotation of crops, changed to blackjack woods mixed with some chesnut; while now it is easy to perceive that these trees are in their turn dying out and giving place to post oak and hickory again, pine and cedar forming an undergrowth, which may hereafter again take the place of the post oaks and hickories.

Where the surface of this region is rolling, we find that planters and farmers have long appreciated its value, but the same cannot be said of the level lands or flats. These, being underlaid by an impervious clay, are thoroughly saturated by water after the slightest rain. They are too level to admit of the flowing off of water, and the consequence is, that it remains there until evaporation removes it. In such locations the plants are said to *french*. This *frenching* is a diseased state of the plant, and, in cotton, can scarcely be distinguished from the *rust*. The query is often made: "What ought to be added to the soil to remedy the evil." It should, however, be recollected, that chemical additions can only remedy chemical deficiencies, while mechanical wants should be met by mechanical counter agents. The defect of these spots is owing to the too great abundance of water in the soil in the spring of the year, when the young plant is sending down its supporting and nourishing roots. Striking the surface of the water at a slight depth, the tap-root ceases to grow, and, therefore, does not descend to a point which, during the dry season, would supply it with moisture. The consequence is, that, although in the early part of the year the plant presents a flourishing appearance, it never attains a full size, and soon withers, without producing any fruit.* A thorough system of

* "I published recently some very curious illustrations of the dislike plants exhibit for stagnant water in the soil. They afforded proof, that directly the roots reach the standing water level, they ceased to penetrate farther. I have evidence now before me that the roots of the wheat plant, the mangold wurzel, the cabbage and the white turnip, frequently descend into the soil to the depth of three feet. I have myself

subsoil drainage is undoubtedly the best remedy, but another may also be found convenient, where local circumstances permit it, and render it economical. It struck me when I first entered this region, that along the margin of these igneoous dykes, or where quartzose veins, traversing them, had given rise to the production of sand, a marked improvement was perceptible in the growth, and I, therefore, recommended the experiment of carting sand and mixing it with the soil. Sometime afterwards, on visiting the plantation of Jas. Crawford, Esq., of northern Chester, I found that he had already successfully tried the introduction of sand on blackjack soils by distributing ditches from his sandy land. This sand, when thoroughly mixed with the soil, renders it more porous and loose, and it hence becomes easier for the water to find a natural mode of exit.

With regard to ditching and ploughing these lands, the objection is urged that it is impossible for the plough to penetrate the clay, which adheres to the share too tenaciously. It is probable, however, that the causes of the difficulty is to be found in the use of an inappropriate plough, an insufficient number of horses, and a lack of skill in the ploughman. If the Tweeddale plough, cutting thirteen inches, be employed, followed by the subsoil trench-plough, cutting six inches deeper, invented by the Marquis of Tweeddale likewise—both so popular in Great Britain—there is but little reason to doubt that this soil can be ploughed deep as well as others. The share of the plough is twelve inches in width, and that of the trencher fourteen, so that no unploughed space is left in the subsoil. For an accurate description of these ploughs, see Stevens' "Farmer's Guide," American edition, 1854, Vol. II, p. 660 and 661.

traced the roots of wheat nine feet deep. I have discovered the roots of perennial grasses in drains four feet deep; and I may refer to Mr. Mercer, of Newton, in Lancashire, who has traced the root of rye grass (which is daily coming more and more into cultivation) running for many feet along a small pipe drain, after descending four feet through the soil. Mr. Hestey, of Orton, assures me that he discovered the roots of mangolds in a recently made drain, five feet deep; and the late Sir John Coury had many newly made drains four feet deep stopped by the roots of the same plant."—*Denton, on the Progress and Results of the Under-Drainage of Land in Great Britain.* Journal of the Society of Arts, Dec. 14, 1855.

If this plan were adopted, the intermixture of the subsoil clay with the soil—the advantageous results of which are universally admitted—would be effected in the most simple and rational manner. The discovery of the benefit resulting from it was made in carting the clay out of railroad cuts on the York and Chester road, over adjacent lands. To say the best of it, this is only attaining the results of subsoil ploughing in a circuitous way, and in a manner which, employed on a large scale, would be productive of far greater expense than could attend the plain and direct method.

With regard to draining, there will be occasion to speak more hereafter. To dwell upon it here, would cause useless repetition.

All the so-called blackjack regions are better suited to grain than to cotton. Indeed, the results of its cultivation prove that its soils are admirably adapted to the former, so that the question: "What are we to do to render our lands good cotton lands?" is best answered by the other question: "If so well suited for grain, then why not grow grain?" Undoubtedly, with the present exorbitantly high prices of all kinds of grain, and with a railroad near at hand, which is the case throughout the whole region, this would be the most profitable crop.

Superb meadows might also be made here with the greatest ease, and as the soil is peculiarly well calculated to produce all kinds of grasses, a trifling expense would suffice to render this region an extensive pasture land, and as such, very probably larger returns than those otherwise derived might be made from it.

The level places, or rather the depressions below the ordinary surface, ponds and swamps for instance, are well adapted to the growth of rice. Mr. Crawford informed me that he tried the experiment on a sixteenth of an acre, and that he made seven and a half bushels of rough rice, or at a rate of one hundred and twenty bushels per acre. Another gentleman near him obtained forty bushels from a quarter of an acre, or one hundred and sixty bushels to the acre. Such results are surely enough to induce continued experiments.

The soils of the *granites*, *gneisses* and *syenites* occupy, as is easily seen by the maps, a very large portion of the four Districts. Granite

and gneiss are both composed of the same materials, quartz, felspar and mica, the difference in the two being only that the granite presents no planes of stratification, which latter characterize the gneiss, and are produced by a parallel distribution of the flakes of mica. In syenite, hornblende replaces the mica, while the other ingredients remain. Of these rocks the gneiss is of most extensive occurrence, and occupies the largest part of Chester. The sandy river lands, for instance, belong to this rock, and they have long enjoyed a high reputation, although injurious tillage has materially decreased their value by producing washes almost everywhere. In north-eastern Chester, it is comparatively quite recently only, that this soil has been properly appreciated, and the rise in its price has, therefore, been remarkable.

The felspar of the granitic rocks, examined in this part of the State, being orthoclase, and this mineral holding a very prominent position among the constituents of the soils, they naturally possess a good deal of potash, a most important and valuable ingredient. To this fact is also chiefly ascribable the improvement which is perceptible in these lands, when they have been permitted to lie fallow for any length of time. The benefit of good subsoil ploughing would doubtlessly be felt very much in such places, as everything which tends to forward decomposition will bring more materials, calculated to nourish the plant, to the surface and within the reach of the roots. This subsoil ploughing will, however, here, as elsewhere, be of little avail without a complete underground draining, as shall be explained hereafter.

Not all of the granitic regions can claim a prominent position in regard to their soils, for, where the surface is such that the sand, derived from the quartz of the rocks, accumulates, we find lands which resemble the tertiary sand region, and which produce the same natural growth, long-leafed pines, chincapins and forked-leafed black-jacks. Such a body of land extends along southern Lancaster, and a marked alteration for the better is perceptible when we strike Capt. Ingram's neighborhood. Here, however, in addition to a want of sand, we meet with the hornblende slate, and readily perceive its improving qualities. This is the vicinity of the Hanging Rock.

Having here given a sketch of the prominent features of the most important soils of the part of the State now surveyed, it will be proper to dwell, to some extent, upon some duties of the agriculturist, which have hitherto received very slight attention in our State, and without which, undoubtedly, no real and permanent improvement in agriculture can take place. It is certainly quite impossible to furnish rules by which, without any expense or labor, an improvement of the soils and of agriculture in general can be effected; yet, from the questions asked, it would almost appear as if something of the kind were considered possible. Besides, an almost innate error exists very generally, which it is difficult to eradicate. The main substance of it is, that no land-holder wishes to spend more in the improvement of his land than that land originally cost. The whole advantage of the cheapness of the land is thus lost. The same men, holding the same amount of real estate in England, would think nothing of spending annually, two, three, or perhaps even five pounds sterling, per acre, in improvements, because there the absolute value of the land will let it appear to them to warrant it. With us, the value of the land is infinitely less, and the improvements must, it would seem, be in proportion to the fee simple; a per centage on the investment. Yet, it stands to reason, that it is less profitable to spend one dollar only in improvements and to make a crop worth five dollars, than to expend fifteen or twenty dollars and make fifty or sixty. The price of the property should be entirely disregarded in the matter. The soils were produced by nature. Soils the same, or nearly so, in quality, are found in different parts of the globe, which, nevertheless, are estimated in different countries at widely different prices. In fact, their local values are, in great part, owing to collateral circumstances, with which this report has nothing to do. The low cost of land in our country ought certainly to be the cause of greater success, instead of effecting a permanent injury upon this species of property.

Probably the most important of all agricultural improvements which our State needs, is a thorough system of *draining*. The astonishing rapidity with which in England, Scotland and Ireland, this improve-

ment has spread, and the advantage which has been reaped from its application, cannot fail to attract the attention of every progressive agriculturist.

There can scarcely be any single measure, the adoption of which would exert so beneficial and extensive an influence upon the agricultural prosperity of the State, and I shall, therefore, venture to dwell somewhat upon the benefits which may reasonably be expected from it, as well as to some extent upon the systems of draining as they are set forth by the most experienced practical experimenters of Europe.*

The advantages of draining are:

1. It removes that chilling moisture from the soil, in the evaporation of which a large portion of the summer's heat is spent before it can directly warm the soil.

2. It prevents the dry season of the year from injuring the plants, because, by the removal of the moisture, it permits the tap-roots to descend to a depth whence the solar heat cannot remove the necessary moisture, even during a drought.†

3. By removing the moisture, it opens the pores of the soil to atmospheric influence, and hence expedites the disintegration of the underlying rocks, and the decomposition of the disintegrated parts, and thus facilitates the production of soil, while—

4. At the same time, this opening of air-passages and introduction of atmospheric carbonic acid and nitrogen, brings these, as nourishment, directly in contact with the roots.

5. It is the only plan to render manures capable of producing the

* Stevens' "Farmer's Guide," American Edition, Vol. II, p. 604–651. An attentive perusal of which pages is certainly to be recommended. Indeed, the whole work is of the utmost importance to the scientific farmer.

† From the "Charleston Mercury," Aug. 25. 1856:

PROFIT OF UNDER-DRAINING.—Mr. Wm. Chamberlain, of Lower Red Hook, N. Y., drained twenty-five acres of land, at an expense of $60 per acre, and the first three crops paid the whole expense, including cost of cultivation. He may then, hereafter, look for a profit of $20 per acre on each crop. Last season, part of his ground yielded seventy-five bushels of corn, another part three hundred bushels of potatoes, while on adjacent undrained fields the crops were nearly ruined by the drought.

greatest amount of benefit, and to prevent their strength being lost by transportation through the medium of the soil-water.

6. It prevents weeds from getting the upper hand, and hence its benefits would be felt very markedly with cotton. It would be much easier to keep the grass under control.

7. It materially increases the healthiness of damp locations.

Even for grazing lands, the benefit produced is surprising. Hard, dry, indigestible grasses give place to sweet succulent and nourishing ones, and only after thorough draining, is the full advantage of subsoil ploughing to be expected.

In an article "on the Progress and Results of the Under-Drainage of Land in Great Britain," by J. Bailey Denton, Esq., published in the Journal of the Society of Arts, London, Dec. 12, 1855, we find that the author designates under-drainage as the "foundation of agricultural improvement, and the most simple and certain means by which the produce of the soil may be increased." When we consider that effective and substantial under-drainage is decidedly the most lasting improvement which can be made in agriculture,* it is certain that notwithstanding a comparatively large outlay of capital at the commencement, it is the most economical of all steps towards a perfection of agriculture. It was in view of this, and of the expense of its first introduction on every estate, that the British Government determined to set apart a sinking fund, from which agriculturists might borrow sums of money with which to effect this important change in their operations. "Mr. Pusey's act, of 1840," says Mr. Denton, "was the first public effort made to meet this want," (the want of money at the commencement, with limited capitalists,) "and although the act itself, from its complications, remained inoperative, it effectually established the principle of enabling land owners, with limited interests, to borrow money for draining, and to charge it upon the lands improved. Mr. Pusey's act, however, was followed in 1846 by the first public-money-drainage act, and subsequently by other acts,

* Mr. Denton remarks that substantial, well carried out draining, will last at least fifty years.

including the private-money-drainage act, and the three several acts for incorporating the existing private companies."

After speaking about the best plans of contriving a return of the investment money in a gradual manner, and without too great pressure upon the borrower of the fund, Mr. Denton enters upon some of the advantages of draining, which his correspondents have experienced. Many, he says, speak of an increased produce of one-quarter the original amount, and none descend to less than four bushels per acre. Some dwell upon the "advantage of doing away with summer fallowing, and in prolonging the wheat seeding time in autumn, and in gaining an earlier fortnight in the spring and at harvest time, estimating the gain in these respects at a greater amount than the increase in cropping." Some speak of the reduction of horse-labor, and of various other advantages. An interesting letter is here introduced from a practical agriculturist of established reputation—Mr. W. Hutton, of Gate Burton, in Lincolnshire. After speaking of the manner in which a drainage contract was there carried out, at a minimum depth of four feet, with a clay soil and a more porous clay subsoil, at a depth of three feet and a half, he speaks of the advantages attained. "Where four horses have frequently had considerable difficulty in ploughing, sheep are now eating off a good crop of turnips; and on old grass land, formerly scarcely of any value to the tenant, the improvement is still greater, as it is now producing excellent crops of wheat, worth almost the fee simple of the land in an unimproved state."

Mr. Donalson, in a discussion on under-drainage in a later number of the same journal, states, that a piece of land in Clydesdale, previously so wet and boggy as to be unfit for cultivation, in the third year after being drained to a depth of from three to five feet, produced a crop of six quarters of wheat to the acre, and sixty-four pounds weight, per Winchester bushel, and have ever since been in profitable cultivation. Another field of three hundred acres, also in Lanarkshire, in the granite region, which had never before been cultivated, producing only coarse grass and heath, after draining produced, as first crop, oats, which sold at public auction at £9 per

acre and the land was let for a second crop, only one year, at £11 per acre.

In Mr. Denton's article we find a table of the sums of money, public and private, applied for, sanctioned and extended up to the 31st October, 1854, furnished by the Inclosure Commissioners, which may not be uninteresting to some readers of this report:

PART OF G. BRITAIN.	PUBLIC MONEY.		PRIVATE MONEY.	
	APPLIED FOR.	EXPENDED.	SANCTIONED.	EXPENDED.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
England, . .	1,940,227 11 6	1,059,804 00 0	292,056 0 0	111,098 0 0
Wales, . .	123,863 00 0	44,2[illegible]7 2 1		
Scotland, .	2,491,167 16 6	1,424,682 17 6	72,083 0 0	17,625 0 0
	4,555,258 8 0	2,528,783 19 7	364,139 0 0	128,723 0 0
To expend, ...		1,471,216 00 5		
Total amount of loan, . .		4,000,000 00 0		

In England various systems of under-draining have been tried, and each has its defenders. The Elkington system was the first attempt, a hundred years ago, and his spring tapping was considered so important an improvement that Parliament voted him a grant of £5,000.

It would be impossible as well as superfluous to enter here at length into a description of all the different processes of draining. It is here proper only to call attention to its importance, and to give some of the most valuable results. Were the whole letter press of this report devoted to this one subject, it could scarcely do justice to it; it is therefore necessary to refer those, who wish to apply under-draining, to the works of Stephens, Low, Loudon, Johnson, Morton and others.

A system, which has been latterly introduced by Lord Berners, and which is called the Keythorpe system, seems to attract much attention at present. By this plan certain natural furrows, which are found to exist on the surface of many subsoil clays, are made subservient to draining purposes, and it is said in consequence, to require less artificial drains than the others, for the drains dug are in reality but main ducts. The plan, however, can only be carried

out after discovering the inclination of these furrows, and undoubtedly requires more observation and experience than is needed in introducing the ordinary methods.

All English writers agree that tile-draining is the plan which should be introduced, to the exclusion of all others, although there may be cases, as with us, where the tiles are at present difficult to obtain, and where, therefore, broken stones may for a time be used to a greater advantage as regards economy. It would, however, be but little expense to import tile machines and to make the pipe-tiles. These pipe-tiles are of very different shapes as seen in sections on Plate IV., fig. 10. Their preference must be decided by experienced advantage as well as by the cost.

In England it seems to be now universally admitted that from 3½ to 4 feet should be the minimum depth of drainage. The gentleman who arranged the improvements on the estate of the Duke of Wellington, conducted a variety of experiments on the relative effect in draining with drains of various depths before introducing any one plan. He found that the deeper the drain, the farther it drained on either side (as is very evident from the fig. 9, on Plate IV., where the lines "ADL, IEM, BFC, KGO," are the drainage planes at various depths of the drains; "AD, AE, AF, AG" being the drains); but that, as the difference becomes less and less the more the depth is increased, while the expense is proportionably greater, there must be a certain point where the increased expense would balance the advantage of greater depth. This he found to be pretty generally at about four feet, but it is easy to perceive that this is a matter which is governed very much, if not altogether, by the price of labor, which, especially where wages are high, will cause a material difference in different ground. Experience can alone furnish the rules in this matter.

As to the advantage of covered drains over open ditches, both as regards efficiency and durability, there seems to be but one voice.

A most important point is the correct position of the drains. A parallel system, arranged, however, with reference to the surface undulations, seems to enjoy the highest esteem.

The distance between the drains should be governed by the depth and the amount of water to be carried off.

In introducing a system of draining upon a farm, the lowest field should be selected to commence the improvement.

Care should be taken not to allow trees or bushes to grow near the drains, as their roots easily cause obstructions expensive to remove.

A good ground plan of the farm should be made when the draining is introduced, and all the drains carefully and correctly inserted; so that afterwards no difficulty will be experienced in tracing up the drains when repairs become necessary.

A more systematic plan of *manuring* is another subject of which it is proper to speak here—a plan based upon a correct knowledge of manures, their chemical composition, the changes to which they become subject by decomposition, and the ingredients demanded by the plants.

The object of manuring is to establish an equilibrium in the soil and to replace the portions consumed. It is effected either by direct addition of those materials themselves, or by the admixture of substances which tend to facilitate the development of the parts needed from combinations already existing in the imperfect soil, (in this respect effecting the same objects as under-draining and deep plowing,) while some manures are added to induce an assimilation between the plants and the ingredients of the soil.

Those manures, with whose properties it is certainly most important that the planter and farmer should make himself acquainted, are the ones which he produces himself, and whose valuable ingredients, therefore, are at his disposal for a less expense than the same constituents in manures, which must be purchased—as for instance guano.

We find in the solid and fluid excrements of animals the ashes of those substances which have served them as nourishment. The fæces contain those parts insoluble in water, while the soluble ones are found in the urine.* The amount of excrements produced daily de-

* Encyclopedia of pure and applied Chemistry, Liebeg, Poggedorf, Wœhler, Kolbe, Vol. II, page 627, (German.)

pends not only upon the quantity of food, but likewise materially upon its quality. Indigestible food affords a far greater amount than food which is capable of more complete absorption by the animal system.* The solid excrements contain, besides the ingredients derived directly from the food, and which in many cases are in their original state, (straw, grains of corn, &c.,) also a considerable proportion of gall with which they are saturated, and which, in excess, renders them slimy. This gall, a segregation of the liver is, correctly speaking, a soap, as the following composition given by Boussingault, of the composition of ox-gall, shows:

Chlorate of soda,†	11.0
Slime, fat,	0.5
Salts,	1.5
Water,	87.0

Elementary analyses of gall by Kemp, Strecker and Gundalach, gave:

	Ox-gall.	Hog-gall.
Carbonic acid,	58.5	64.5
Hydrogen,	8.3	8.8
Oxygen,	22.6	11.9
Nitrogen,	3.7	3.3
Soda,	5.6	11.5
Chloride of Sodium	0.4	
	100.0	100.0

An analysis of the ashes of human fæces by Berzelius, gave:‡

Phosphate of Lime, Phosphate of Magnesia, and Gypsum,	66.66
Sulphate of Soda, Sulphate of Potash, Phosphate of Soda,	5.53
Silicic acid,	10.66
Carbon and loss,	12.00

An analysis of the ashes of the fæces of a horse, by Jackson, gave:§

* Boussingault (by Graeger) on Agric. Chem. (Germ.) Vol. III., p. 82, &c.

† In the German translation probably a misprint for chloride of sodium.

‡ Encyc. p. & a. Chem.

§ Ibid.

Phosphate of lime,	5.00
Carbonate of lime,	18.75
Phosphate of Magnesia, and Phosphate of Soda,	36.25
Silicic acid,	40.
	100.

An analysis of the ashes of the fæces of a cow, by Haidlen, gave:*

Phosphate of lime,	10.9
Phosphate of Magnesia,	10.0
Silicic acid,	68.7
Phosphate of iron,	8.5
Lime,	1.5
Gypsum, Chloride of Potassium, and Copper,	3.1
Carbon and loss,	1.3
	100.

Dr. Higgins, in his agricultural report on Maryland, estimates the value of the fæces of one human being at seven dollars per annum, basing his calculations on the cost of their useful ingredients in guano. In China they are applied on the most extensive scale (see Father Huc's travels,) and in a dried and pulverised state (poudrette) in France and Flanders likewise. The objections offered to its use are in reality puerile, and the same might be made to every kind of nourishment we imbibe, for undoubtedly at some period or other, the ingredients of which it is composed, passed through phases in which we would not have been willing to use them as food. Besides it is easy to perceive that the manure undergoes a complete change before being used by the plant, and elements or combinations of elements are extracted, which can not be possessed of impurities any more than the same elements derived from other sources; nor is there any logical reason why we should be willing to use the excrements of one animal and not of another, especially when analysis and experience prove that the one we eschew enjoys advantages over the rest.

* Encyc. p. & a. Chem.

With regard to urines, also, Boussingault, in the work already quoted, remarks that the nourishment produces important differences, but that these are likewise effected by the organization of the animal. Thus, besides ucrea, we find uric acid almost always present in human urine. The urine of birds and reptiles is particularly rich in this acid, which has, however, not yet been discovered in the urine of herbivorous animals. Basic phosphate of soda, and indeed phosphates altogether, which are never absent in human urine, are not to be found in that of the herbivoræ under ordinary circumstances of feeding. The urine of mammals is characterized by urea; that of herbiverous mammals, additionally by hippurate of potash, and generally, also, by bicarbonated alcalies. The consequence is, that muriatic acid produces strong effervesence in fresh horse or cow urine, after which crystals of hippuric acid collect. This acid consists of:

Carbon,	60.7
Hydrogen,	5.0
Oxygen,	26.3
Nitrogen,	8.0
	100.

By its decomposition, and that of the urae, the carbonate of ammonia is formed, which is of so great importance as a manure.

In fresh urine of herbivoræ, Boussingault found traces only of carbonate of ammonia, as the following table shows:

Urine of a milch cow,	0.06
Urine of another cow,	0.10
Urine of another cow,	0.09
Urine of a camel,	0.04
Urine of a horse,	0.04
Urine of another horse,	0.00
Urine of a rabbit,	0.03
Urine of another rabbit,	0.02

From the following analyses of fresh urines, it will be seen that they contain all the ingredients most necessary for plants, with the exception of the phosphates, which are to be found in the fæces.

They contain carbonate of potash, of such great importance to vegetation, as well as sulphate of potash and nitrogeniferous substances, by whose decomposition carbonate of ammonia is produced. It is only, therefore, in a decomposed state that the full benefit of urine can be obtained.

	Urine of a cow.	Urine of a horse.	Urine of a hog.
Urea,	18.5	31.0	4.9
Hippurate of potash,	16.5	4.7	0.0
Alcaline lactates,	17.2	20.1	undetermined
Bicarbonate of potash,	16.1	15.5	0.71
Carbonate of magnesia,	4.7	4.2	0.9
Carbonate of lime,	0.6	10.8	trace
Sulphate of potash,	3.6	1.2	2.9
Cloride of sodium,	1.5	0.7	1.3
Silica,	trace	1.0	0.1
Phosphates,	0.0	0.0	1.0
Water, &c.,	921.3	910.8	979.1
	1000.	1000.	1000.

In Boussingault's work a number of important facts regarding these manures may be found; facts, however, into which it would not be proper to enter into a report as brief as the present.

To preserve the valuable ammonia of the urines, Leibig recommends the use of gypsum (see his agricultural letters); but Boussingault's condemns it, as well as proto-sulphate of iron (copperas), as both these substances convert the important carbonate of potash into a sulphate; a salt of little beneficial influence with the plants. Johnston recommends pulverized charcoal for the absorption of ammonia. This material has a great additional advantage in its cheapness, and in the facility with which it can everywhere be obtained. Carbonate of lime is highly injurious, if coming in contact with the manures before they are distributed over the field, since its decomposing effects liberate and discharge all the ammonia. When lime is used it should be thoroughly mixed up with the soil before any manure is added.

The importance of stable manures and the necessity of preserving them, leads me to another topic, which, owing to the suggestions of his Excellency Governor Adams, in his message last year, has attracted much attention in our State. I allude to the proposed alteration in the *fencing* laws; for, although it does not behoove me to speak of the propriety of the proposed measures in a political point of view, yet, it may not be useless to state some important facts regarding it, which my itinerant duties have enabled me to observe. As to the propriety of introducing this topic into a report like the present, I believe that the fact of the addition of agricultural investigations to the duties of the survey, and the importance which this subject occupies in agriculture, will make it admissible.*

As calculations, facts and figures, where in reality all circumstances are considered, are capable of rendering cases more evident, and are also the means of making a subject of this description fully comprehensible to all, I shall attempt, as far as my means of obtaining information extend, to present, in a concise manner, every point that refers to this important topic. In doing so, I beg to express my obligations to the members of the Fishing Creek Agricultural Society, (where the new movement was first proposed, some years ago,) for the data with which they kindly supplied me, and for calling my attention to some facts which might otherwise have escaped my notice.

CALCULATION OF COST OF TEN PANNELS, OF TEN RAILS EACH.

The value of the timber needed for 100 rails may, on an average, be considered to amount to.......................................$ 50

Cost of splitting one hundred rails,...................................... 50

One negro and a two horse wagon can, in a day, haul 2,000 rails one half a mile, (which is probably as fair an average distance required through the State as we can arrive at.) Considering then the hire and keeping of negro, wagon and

* Though this be regarded as irrelevant matter in a geological or geognostic report, it can scarcely be considered as more so than the chapter on the Shaking Quakers in Mr. Jackson's report on the geology of New Hampshire.

two horses, at three dollars per day, we have for hauling 100 rails,.. 15

One hand can, in a day, lay his worm and put up sixty pannels, of ten rails each. Considering the hire of one hand per day, at fifty cents, we have for putting up 100 rails, 08$\frac{1}{3}$

The food for this hand being estimated at twelve and a half cents a day, we have the proportion for 100 rails, of......... 02$\frac{5}{6}$

The absolute cost of ten pannels, of ten rails each, as they stand, would therefore be,...$1 26$\frac{1}{6}$

In a mile there are about seven hundred of such pannels. Thus far, it is comparatively easy to make an estimate; but it is much less so when we desire to ascertain the probable number of miles of fencing in the State. It is believed, however, that we may safely say, there are at least three running miles of fence to every square mile in the State. Some have thought four miles not too much.*

In making these estimates, it should be recollected, that the smaller cross-fences add largely to the sum total, and that, wherever there is a road of any size, there are fences on both sides. In Chester and Fairfield, for instance, almost every road is flanked by fences on both sides, and, though the swamps of the Low-country may lessen the amount of fencing locally, yet the exceedingly large amount of fencing in the middle districts, and the number of small farms in the mountain districts, (which of course cause proportionably more fencing than large plantations,) will greatly increase the sum. There is really every reason to believe that three miles per square mile is a very moderate calculation. Perhaps at some future day, arrangements may be made to determine the amount definitely.

Our State occupies an area of thirty thousand square miles, so that, according to the estimate made, we would have ninety thousand miles of fencing of seven thousand rails to the mile, making the number of rails six hundred and thirty millions (630,000,000). One

* James Crawford, Esq., of the Fishing Creek neighborhood, in Chester, calculated the amount of fencing on his plantation, of 1,000 acres, and found it to exceed fourteen miles. Similar calculations were made for me elsewhere.

hundred of these, costing $1 26¼ cents, we find the cost of the whole fencing in the State to be $7,948,500 (seven millions nine hundred and forty-eight thousand five hundred dollars).

The necessary annual repairs renew the outlay once every ten years, and we must to this sum add the running interest on the capital invested; which, of course, greatly increases the sum. But as this interest on the running capital—the capital annually invested—is but a small portion of the interest of the whole capital hitherto invested, and, as it is impossible to form any idea of the whole capital, and consequently of its interest, it will scarcely be proper to introduce this small portion of interest here. The calculations, therefore, refer only to the actual annual expenses. For ten years—the period an ordinary fence is considered to last—this sum is $7,948,500, or for one year, $794,850. This sum is expended with no other view than that of preventing the loose cattle from effecting injuries to the fields. According to the United States census of 1850, the value of the whole live stock of South Carolina is estimated at fifteen millions sixty thousand and fifteen dollars, ($15,060,015). This live stock consists of:

Horses,..	97,171
Asses and mules,..	37,483
Milch cows,..	193,244
Working oxen,..	20,507
Other cattle,..	563,935
Sheep,..	285,551
Swine,..	1,065,503

In this list are included both horses and mules, which, being usually either worked, stabled, or pastured in closed pastures, should not be enumerated among those, to protect the fields against whose encroachments the fences were made and are maintained. Their value should therefore be deducted from $15,060,015. The estimate of the value of the horses and mules is not given in the census report; but, at present high prices, I think we shall not exceed the correct amount if we consider horses and mules to be worth at least as

much as all the other live stock put together, so that we would really spend more than the whole value of all these cattle, sheep and swine, every ten years, not for the purpose of supporting them, or of rendering them any benefit, but solely with a view to prevent this species of property from becoming injurious to other property. This is the only reason that can be given for retaining the present law, which obliges every land-holder to erect and maintain fences. It is an arrangement, however, which is, it would seem, strongly combatted by the following objections, in which the question is of course not alluded to, whether this protective measure, originating at an early stage of colonization, is opposed or not, to the maxims which govern our whole internal policy.

The objections then to the present fencing system are the following:

1. The great expense devoted to effect an object, which might be attained far better by much simpler means.

2. That large bodies of land (in the aggregate) and of the best land too, are absolutely lost to cultivation. I allude to the running strip of land, nearly a rod in width, which must be left—one-half on either side of the central line of the fence—for the horse to turn, in ploughing.

3. The increasing difficulty of obtaining timber for rails.

4. The fact (resulting from this scarcity of timber), that many valuable plantations and farms are abandoned, simply because there is not sufficient timber on them to enable them to be fenced. This is a misfortune greatly on the increase, and is a conspicuous cause of the emigration westward from our State.

5. The rapid consumption of the best timber which it occasions, and

6. The consequent injurious effect which it exerts upon those industrial pursuits that require timber for fuel as well as for lumber.

7. The fact—and it is a most important one—that the more land we clear, the smaller the pasturing ranges for the cattle become, and that, consequently, the half-starved animals require stronger preventives to protect the fields from their incursions. We now need

much higher fences than formerly, and the necessity for stronger and higher fences is in proportion to the decrease of the timber.

8. The fact that the present system renders the preservation of choice breeds of cattle from adulteration more difficult, and tends materially to check the spirit of improvement in cattle.

9. The fact that no manure, worth mentioning, is saved under the present system. This is the more immediate cause of the introduction here of these remarks. That manure, which is dropped in the old fields, loses most of its beneficial qualities by exposure; while the tramping down of the earth by the cattle more than obliterates the small benefit otherwise accruing.

If the cattle were kept up, or herded and well fed, their manure might easily be saved, besides being greater in quantity; while the saving in the cost of fencing would amply repay the labor of distributing it over the fields.

The objections urged against the abolition of the present fencing law, are:

1. That it would benefit the rich man at the expense of the poor man.

If by the poor man is meant the small land-holder, it should be recollected that, owning less land than a large planter, and having, on that account, smaller fields, with him the proportion of fences to the number of acres will be greater than with the other; consequently, that he will be most benefitted by the change advocated.

If the tenant is the one alluded to, the observation appears equally incorrect. Tenants are obliged to keep the fences in repair, and they often are forced to rent poor land at high prices, in preference to rich land at a low price, merely because the former possesses timber for fencing and the latter not. Neither the small land-holder nor the tenant can, therefore, be benefitted by the present law, particularly as with both the cost of labor, owing to retail purchases, &c., is greater than with a wealthy man.

2. Another objection to a change, is an entirely negative one, viz: that the time spent in building and repairing fences is in odd moments, when there is nothing else to be done. To refute this, it

seems but necessary to point to the month of March, 1855, when fires swept away many fences all over the State, the re-construction of which certainly required time that might have been otherwise advantageously employed. But, indeed, a farmer or planter has no spare time thus to employ, especially if his crop is as time-engrossing as that of cotton. If there should be any unoccupied time, would it not be far better to devote it to a really useful object (e. g. manuring) than to one which cannot be regarded as otherwise than wasteful and hence injurious?

3. A third objection urged is, that the frontier farms and plantations would suffer from encroachments from cattle of other States. Along the Georgia line the Savannah River and its sources would afford sufficient obstructions to their passage. North Carolina is therefore the only State of which it is necessary to speak. An abolition of the fencing laws would not prevent those who wished to retain fences from doing so. Besides, there seems no reason why cattle from other States, committing depredations with us, should not become amenable to our laws. These apparent inconveniences even could, however, last only for a short time, as the great advantages resulting with us would soon induce other States to follow our example.

The time for legislative action in this matter to be of importance is rapidly drawing to a close in many parts of our State; for the want of timber will, in a number of districts, of itself, soon abolish these laws. Already in large parts of Chester, for instance, woodlands sell at double the price of cleared lands, the former averaging from fifteen to twenty-five dollars, the latter from six to twelve dollars.

An important fact, which should not be forgotten, is, that denuding lands, in mountainous regions especially, of their forest covering, has been found to diminish the fertility of adjoining lands in a most extraordinary manner. Boussingault treats these effects at length, and Dr. K. Mueller, in the German enlarged edition of Boussingault's work,* gives additional instances of the evil effects of

* Die Landwirthschaft in ihren Beziehungen zur Chemie, Physik and Meteorologie von J. B. Boussingault, deutsch von Dr. N. Graeger, 2d Edit. Halle 1851–1856, Vol. II p. 432, &c.

removing forests. In southern France and in Switzerland, numerous illustrations are found of the injury done in this manner to the productiveness of soils and of the increased inundations, caused by denuding the highlands of their growth of timber. In Italy we now find, in consequence of the same process, the Pontine swamps, where once existed the fertile plains of the Volscians. In a larger report, this subject alone might fill a long chapter.

A matter which deserves to receive the attention of agriculturists, is the advantage to be derived from *meteorological observations*. Prof. Henry, of the Smithsonian Institute, dwells to some extent upon their value, in a letter which was sent to the Secretary of State, and afterwards handed over to me, as having reference to this department. I append it to the report as its perusal may be interesting to many readers.

It would be a great presumption to suppose, that all the remarks contained in this chapter should be new to every one who may honor them with his perusal. Nevertheless it is to be hoped, that many will find subjects of interest contained in it; and simple repetitions even may not be valueless under circumstances like the present.

LETTER OF PROFESSOR HENRY, OF THE SMITHSONIAN INSTITUTE, ON METEOROLOGICAL OBSERVATIONS.

SMITHSONIAN INSTITUTE, Washington, Dec. 29th, 1855.

DEAR SIR:—We have been informed that a law has been passed by the State of South Carolina, appropriating annually, $5,000* for the purposes of investigations in agriculture, and we write to enquire whether a small portion of this fund cannot be applied to the establishment and support of a few permanent meteorological stations in your State.

I need not impress upon you the importance of observations of this kind, when simultaneously made with reliable instruments at different points throughout a country, and in accordance with a well organized system.

* It will be seen that the amount and object of the appropriation was misunderstood. The sum was only $3,000. O. M. L.

There is no subject of more general popular interest than that of the changes of the weather, and the relative temperature and humidity of the district we inhabit. And when we consider that climatic influences enter even into the constitution of national habits and peculiarities, determining as they do, in part, the pursuits and temperament of an entire people; or, when we reflect how much of our personal comfort and convenience depends on the climate in which we live, and how sensibly our feelings, and even our mental operations, are influenced by the pressure, temperature and electricity of the air, it becomes apparent that any researches which may tend to throw light on the laws which regulate the variations of these elements, must be viewed with interest and approbation by all who are capable of appreciating the value of scientific certainty with respect to those atmospheric changes by which we are so constantly and intimately affected.

But meteorological observations are not alone interesting from a purely scientific point of view. The facts which they reveal are directly applicable to the wants of the husbandman; they aid in enabling him to predict, without a ruinous series of trials, what plants he can safely cultivate, or what animals he may succeed in rearing. The amount of heat and moisture in given places being known, together with their comparative distribution through the several seasons, the farmer can determine, whether in the course of a number of years he will be a gainer or loser by introducing the culture of a plant new to his locality.

In all the educational establishments of Europe for the diffusion of a knowledge of agriculture, meteorology forms a prominent branch of study, and in all countries in which the art of husbandry is encouraged by public bounty, systems of meteorology are established.

The practical value of meteorological statistics is not, however, confined to the farmer, but is shared by the engineer and the physician. The former employs them in his estimate of the supply of water, which can be obtained for the purposes of locomotive or mechanical power, and the latter, in the study and amelioration or cure of diseases. To the mariner, a knowledge of the currents and winds of the

ocean is of the greatest importance; but these can never be fully understood, or their changes predicted, without a series of contemporaneous observations on the land as well as on the sea.

The value of systems of simultaneous observations, in a uniform plan, is now more widely known, and more highly appreciated, than ever before. National governments, in almost every part of Europe, have established them, and in this country, the general government, as well as the legislatures of several States, have made appropriations for the same purpose. The Medical Bureau, under the direction of the Surgeon General, has supported, for a number of years, a system of such observations at the principal military posts of the United States. The State of New York has carried on, for a quarter of a century, a similar system within her boundaries; and Pennsylvania, Massachusetts and Missouri, have adopted a like liberal policy. The Smithsonian Institute has undertaken to collect and digest all the scattered observations which have been made on this Continent, and also to establish a system of new stations in different parts of the United States. The Institution has also, within the past year, made an arrangement with the Patent Office, by which the expense of the reduction and publication of the annual returns of the system, carried on under the former, will be partially borne by the latter. A full account of the observations made during the years 1854 and 1855, will be appended to the next report of the Patent Office, and the results of the materials which have thus far accumulated in the office of the Institution will be gradually given to the public as the means for printing them are furnished.

The British Government is about to establish a system in its North American possessions, and this, with the co-operation of a few more States, of which South Carolina would be a very important one, will enable us to trace changes of climate, and the progress of storms, from the Gulf of Mexico to near the Arctic regions.

Four or five stations would be sufficient to establish the climatology of the State, and the expenses for their outfit and support comparatively small. Reliable instruments can be procured at about fifty

dollars a set, and an annual appropriation of fifty dollars for each observer would secure valuable results. The Smithsonian Institute will furnish blanks and instructions.

I am, very respectfully, your obedient servant,

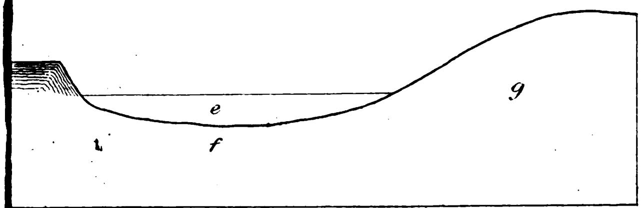
JOSEPH HENRY,

Secretary S. I.

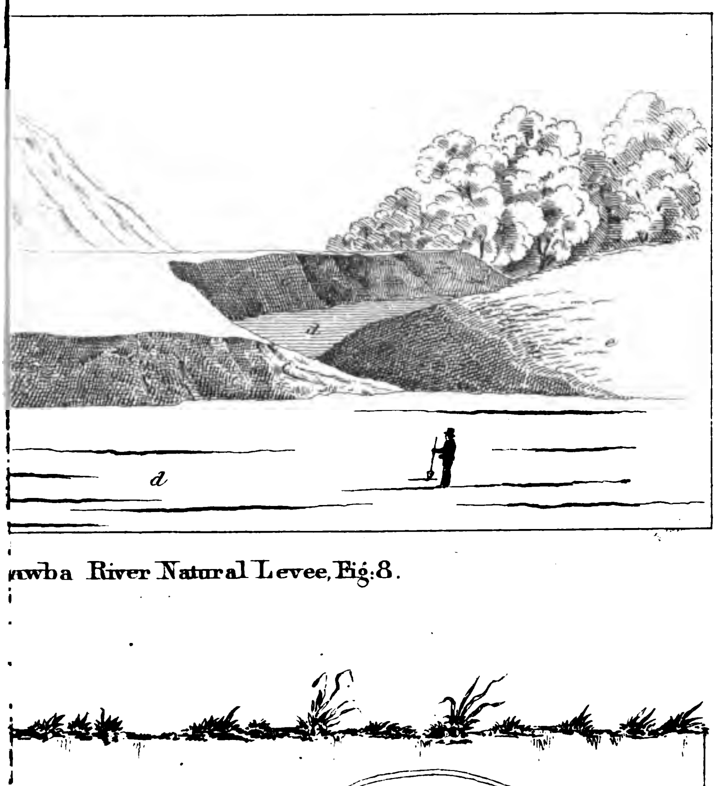
HON. BENJAMIN PERRY, *Secretary of State of South Carolina.*

ERRATUM.

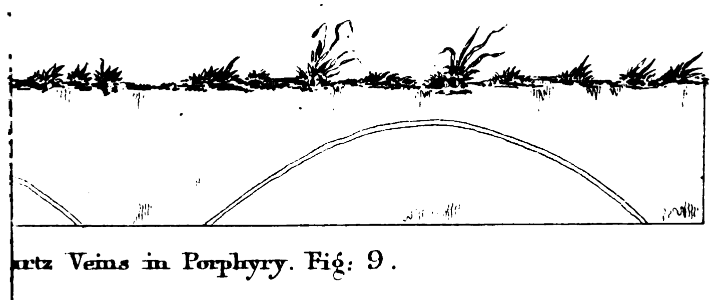
On Plate VIII, representing Chester District, the two dykes, one just east and the other just north of Chesterville, colored *white* on the map, should be *diorite*.



River Deposits. Fig: 7.



wba River Natural Levee, Fig: 8.



rtz Veins in Porphyry. Fig: 9.

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